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THE PHYSIOLOGY OF ARTHROPLASTY*

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I desire to express my appreciation of the signal honor you have conferred in selecting me to give the first Sir Robert Jones Lecture. I feel this keenly for two reasons, each of which is of equal importance. First, that I should serve, even in a small way, this great institution—The Hospital for Joint Diseases—which has contributed so much to the advancement of science and the relief of humanity; and, secondly, on account of the name which has been given to this lectureship. I am grateful for the opportunity to publicly pay my humble tribute to Sir Robert Jones, not only to his great attainments as an orthopaedic surgeon, but also to his lovable character as a man who has endeared himself to the surgeons of all countries, who have had the pleasure and opportunity of personal contact. I cannot refrain, on this occasion, from also expressing my respect and regard to the memory of the founder of this institution—Dr. Henry W. Frauenthal.

Arthroplasty, or the reconstruction of an ankylosed joint by surgery for the purpose of restoring function, is a recognized surgical procedure which requires no further detailed description. Since there is very little known as to the evolutionary process of nature by which such a joint is restored, this discussion will be confined entirely to this phase of the subject. The clinical aspects of arthroplasty by the methods from which conclusions are drawn have been reported previously in detail in former contributions. The main principle of our method is the reconstruction of a joint as simply as possible, which will restore function without regard to anatomical detail. A double layer of fascia lata is interposed between the reformed articular surfaces, thus reproducing as nearly as possible the primitive embryological joint. Conclusions have been drawn as to the physiological and histological evolution by several factors which may be enumerated as follows:

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1. Animal experiments.
2. Clinical or functional results.
3. "Spontaneous arthroplasties" after destructive processes in joints and ununited fractures.
4. Biopsy and autopsy of joints in which function has been restored by arthroplasty.
5. Successive roentgenograms of joints in which function has been restored by arthroplasty.

Animal Experiments.—As frequently stated, animal experiments are of slight value in elucidating the problems of arthroplasty, and knowledge must be acquired almost entirely upon the living human. In the first place it is most difficult or impossible to secure animals with analogous pathology,—*i.e.*, joints in which ankylosis has occurred; and, secondly, it is impossible to secure intelligent cooperation to evolve a joint by functional adaptation, which is absolutely essential to success. On this account, a detailed discussion of the various experiments will be omitted and only a few mentioned. Murphy resected joints in dogs and interposed fat and fascia. He concluded that the fat undergoes certain changes conducive to the formation of bursae or hygromata. Neff reports one successful arthroplasty in a dog, using free transplants from the aponeurosis of the rectus muscle. A new capsule formed and two bursal sacs developed. Phemister and Miller experimented with three series of dogs: in one, a free transplant of fascia lata was interposed, in one a pedicle flap of fat and fascia, and in the third no material was interposed. In all, the results were identical, the tissue interposed being absorbed at the points of greatest pressure, and a fibrous ankylosis of the articulation resulting, with or without interposition of tissue. These facts are of importance in proving that no material knowledge of practical value can be gained thereby. There is no intention, however, to underestimate the necessity of animal experiments which have been meticulously carried out, for a negative finding often contributes as much or more to the sum total of knowledge as a positive.

Clinical or Functional Results.—In those joints in which satisfactory function has been secured, the external contour is changed, as some of the bony landmarks are not so prominent,—for instance, the patella and lateral sulci of the knee may not be visible, the joint becoming more cylindrical. On palpation the new contour, conforming to the reconstructed joint, can be elicited. Active motion is usually commensurate with passive motion, the range secured varying in different joints. Passive motion in some instances may exceed that of active motion, depending upon the quality of the musculature and the voluntary efforts of the individual during the after-treatment. The degree of muscular development possible differs in normal individuals and also the muscle power may vary in the different joints after arthroplasty. For example, in the elbow the triceps may be weak and extension accomplished largely by gravity; in the knee, full extension may not be possible against gravity; and in the hip, flexion to the full range may not be possible. In many instances there may be slight

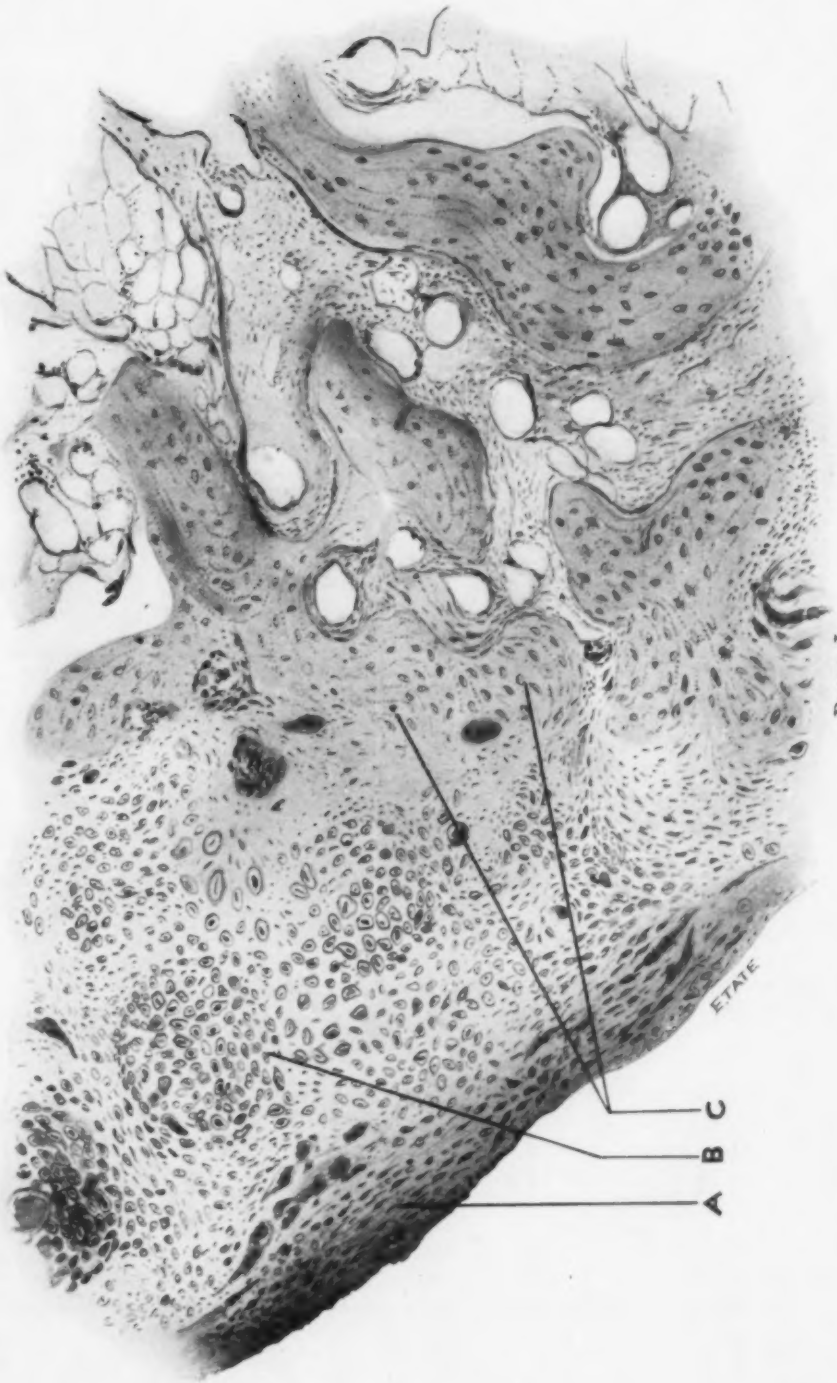

PLATE I

Drawing of microscopic section from a spontaneous arthroplasty of hip joint thirty years after acute pyogenic infection with subsequent osteoarthritic changes. About fifty degrees of free motion was present in all directions. Note construction of the new joint which is composed of three layers: (*A*) superficial fibrous connective tissue, (*B*) fibrocartilaginous and hyaline cartilage, supported by (*C*) spongy bone. Note also invasion of fibrous tissue from the osseous spaces.

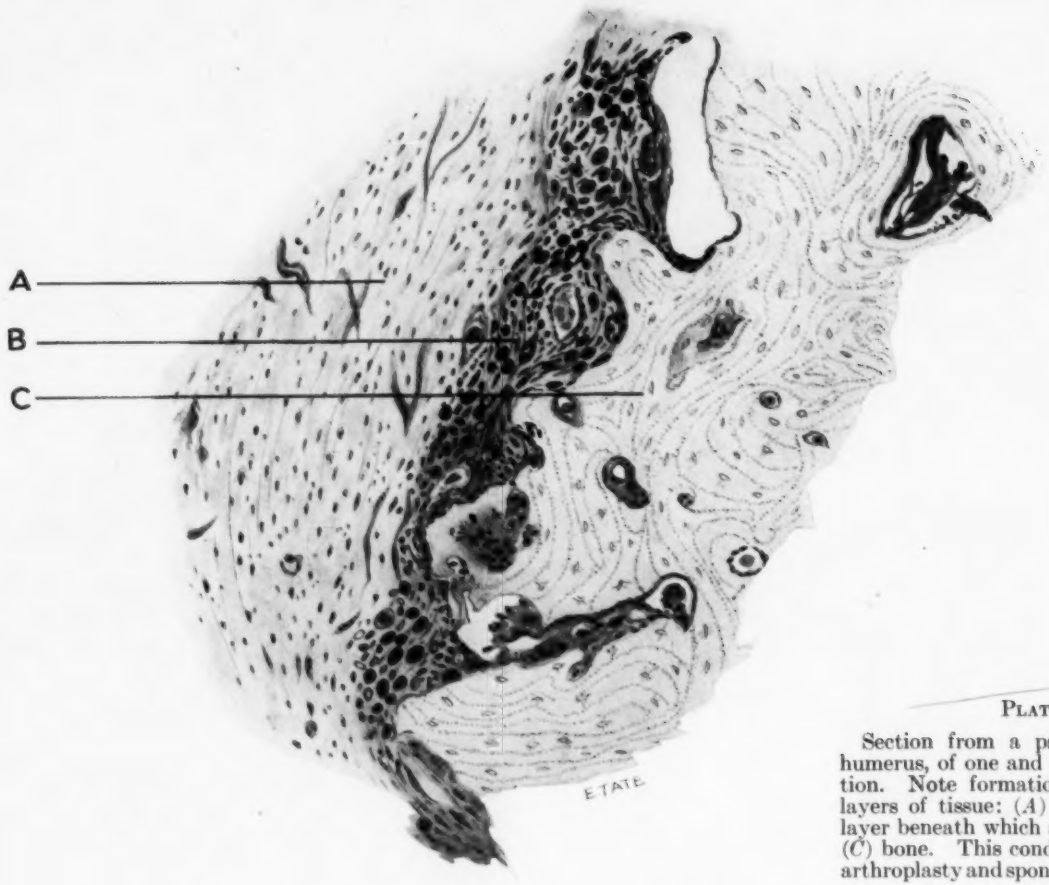

PLATE II

Section from a pseudarthrosis of the humerus, of one and one-half years' duration. Note formation of three different layers of tissue: (*A*) a superficial fibrous layer beneath which are (*B*) cartilage and (*C*) bone. This condition is analogous to arthroplasty and spontaneous arthroplasty.

motion in an abnormal direction, as lateral motion in the knee, although not sufficient to impair function. In the non-weight-bearing joints normal motion is not unusual, whereas in the weight-bearing joints the normal range is rarely secured or desired. The weight-bearing joints in the most satisfactory results acquire about sixty per cent. of normal motion; beyond this point the joint is not so efficient or stable, and the muscular power often inadequate to carry out the degree of motion possible. There is usually more or less crepitation elicited on motion; but in some, the motion is free and easy. The joint secured is durable and practically efficient, but not to the same degree as a normal joint.

Spontaneous Arthroplasty.—"Spontaneous arthroplasty" or the reconstruction of a joint by nature, after the joint has been completely destroyed by a pathological process, is not infrequently observed. Osseous fusion of dense fibrous adhesions does not always occur, even after there has been complete destruction of the articular surfaces. A new joint may be formed by functional adaptation, probably from slight movement in the joint which gradually increases as the acute symptoms subside. The salvage of a joint may occur often in this manner after an acute process in any articulation; but the status of such a joint is best demonstrated by the roentgenograms of those in which the hip was involved, which is illustrated by the following cases:

CASE 1. Mrs. H., age twenty-one years; in childhood had a long continued destructive process in hip, which healed after years of treatment by the late Dr. E. H. Bradford. On examination the patient had only a slight limp with a practical range of motion in all directions. The roentgenogram revealed that the original acetabulum, when compared with the opposite side, had been completely destroyed and that the receiving cavity was higher than normal and much enlarged. The head of the femur was entirely destroyed, leaving as a substitute a conical neck articulating with the acetabulum. From the extensive destruction of bones without apparent reaction of proliferation or condensation, an acute infectious process can be excluded with the probable diagnosis of a low-grade infection, such as tuberculosis. The case demonstrates clearly, how, after extensive destruction, a serviceable joint may be conserved by a natural process. As there was no operative intervention, the evolutionary changes of functional adaptation could not be observed. The question as to whether such a joint should be obliterated by fusion is a present-day surgical problem and not pertinent to the subject in question.

CASE 2. Mrs. E., aged sixty years; was injured in an automobile accident three years previous to observation and was confined to a hospital for many months. Since that time she has had limp and disability of right hip joint. On examination, the patient walked with a slight limp and the range of motion in the hip was about fifty per cent. of normal. Roentgenograms revealed complete destruction of the head, a thin conical neck articulating with a very irregular acetabulum. No treatment was advised, as the patient had a fair amount of endurance.

CASE 3. Mrs. R., age thirty years; three years previous had a very acute infection of the right hip joint, since which time there has been pain, disability and deformity which required the use of crutches when walking on the street. On examination, there was found a pronounced limp. The hip was flexed 150 degrees. There was about thirty degrees of motion in all directions. The roentgenogram demonstrated the head and acetabulum smaller than normal, and the joint space diminished to much less than normal. The osseous reaction of proliferation and condensation was suggestive of a

previous pyogenic infection. The deformity was corrected and a practical range of motion was restored by a plastic operation to relax the contracted flexor muscles.

CASE 4. Mrs. V., age forty-five years; gave a history of an acute infection in the left hip during childhood. After the acute symptoms subsided there was limp with slight disability until the past three years, during which time pain and disability had so increased that she was totally disabled from earning her livelihood as a seamstress. Examination: The patient walked with a decided limp; the left hip was flexed 150 degrees. There was about fifty degrees of free motion in all directions. The roentgenogram demonstrated a very irregular joint with marked proliferation and condensation. The diagnosis was the residual stage of acute infectious arthritis, with subsequent osteoarthritis, due to constant use of an incongruous joint. An arthroplasty was performed October 4, 1928. On incision into the joint, the acetabulum and head of the femur were found to be irregular; there was osteophytic formation about the margins and scattered areas of degeneration and fibrillation of the cartilage. The ligamentum teres had entirely disappeared, the synovial membrane was largely substituted by an invasion of fibrous tissue. The microscopic examination of a specimen removed from the acetabulum and from the head of the femur demonstrated a superficial layer of dense fibrous connective tissue, beneath which was a layer of fibrocartilage. There were definite degenerative changes in the cartilage; beneath the cartilage was the supporting normal spongy bone.

Sections of other cases demonstrated similar manifestations.

Sections were removed at operation from numerous ununited fractures. The description of two cases will be sufficient; the first was an ununited fracture of the humerus of one and one-half years' duration. At operation the false joint, with the capsule, was completely excised and sent to the pathologist for study. This revealed, on incision into the fracture line, each fragment of bone covered by a white translucent layer which appeared to be cartilage, flat and smooth; there was a definite capsule and joint fluid. The microscopic examination was as follows: There was a superficial layer of dense fibrous tissue which merged into a layer of atypical cartilage that might have been described as metaplastic cartilage. The fibrous tissue was more homogeneous, but there was no definite cartilage matrix; the true cartilage cells were more prevalent nearer the superficial fibrous layer. Beneath the cartilage there was dense bone.

The second was an ununited fracture of the neck of the femur of three months' duration. Central fractures of the neck of the femur reach a status of non union in much less time than fractures in any other portion of the skeletal system. The specimen demonstrated macroscopically a typical ununited fracture with the articular surfaces covered by apparently fibrous tissue, but a definite joint space. Microscopic examination demonstrated a quite cellular layer of fibrous tissue that invested the bone and was continuous with the marrow. The fibers were closely compact and their course was in a general direction transversely to the fractured osseous surfaces. Many of the nuclei of the cells were flattened between the fibers. Definite cartilage cells could not be demonstrated, but at this early stage many are probably precursory to cartilage cells, which are observed in ununited fractures of longer duration.

The status of a joint reconstructed by nature, after a pathological process or trauma, is not analogous to an ununited fracture, but somewhat

FIG. 1

Spontaneous arthroplasty of the left hip three years after acute arthritis of pyogenic origin. A new joint has been reconstructed by natural resources. Note close resemblance to a joint after reconstruction by arthroplasty.

FIG. 2

Arthroplasty of the right hip five years after operation. The joint space is less than that of a normal joint and there is condensation of bone beneath the articular surfaces of the head of the femur and the ilium; there is also rearrangement of bone trabeculae by functional adaptation, following the new lines of stress.

FIG. 3

Arthroplasty of the right hip twelve years after operation. Practically perfect motion was secured, but note extensive proliferation of bone which is not incompatible with good function.

similar. In both there is movement. In the joint there is organized function with muscles so placed as to permit voluntary active motion. In an ununited fracture the motion is entirely passive and has no relation to function. In both there is friction. The similarity of the histological evolution of a spontaneous arthroplasty and an ununited fracture is thus quite evident.

Biopsy and Autopsy.—Biopsy and autopsy of joints in which function has been restored by arthroplasty, undoubtedly will give more definite information of the culminated histological evolution of the reconstructed joint. As the procedure is comparatively new, only one postmortem examination has been made, which was by Sudhoff, two years after arthroplasty of the elbow, the patient dying of some intercurrent disorder in no way related to the arthroplasty or to the former infection which caused the ankylosis. The result was satisfactory; there was a range of motion from 45 to 165 degrees. On incision into the joint, the articular ends were smooth in all parts and covered with white fibrous sheets of connective tissue, two or three millimeters in thickness, which were attached to the cortex. The fascia could not be recognized. At points of greatest pressure there were bluish-white areas resembling cartilaginous tissue. The joint space in the anterior portion was interrupted by a septum which formed a bursal cavity. Microscopically, the capsule consisted of thick connective tissue, poor in cells; the bursal lining contained no endothelial cells; however, there was a profusion of large cells found here and there lining the wall. The articular plates were made up of fibrous tissue poor in cells and blood vessels and contained here and there connective tissue cells and nests of hyaline cartilage. The cartilage cells appeared to have had their origin in the bordering marrow and the periosteum. The connective-tissue fibers in places extended from the marrow interstices into the articular sheets.

Baer, who interposes a prepared animal membrane—chromicized pig bladder—has had occasion to open four joints after arthroplasty. His findings were as follows: "In the joints the membrane had been absorbed but a space following the outlines of the joints persisted in each case. The lining of the cavity was perfectly smooth. The microscopic sections made from the walls of these newly formed joints were as follows: The chromicized bladder had been invaded by round-cell infiltration from the side next to the denuded bone. The round cells permeated the membrane which at first became quite cellular in character. These cells finally became diminished in number and the tissue adherent to the bone was changed into a fibrous mass. The cells toward the joint side became flattened out, but there was no distinct endothelial lining to the joint. The fibrous tissue on the adjacent bones showed no tendency to coalesce. A very noticeable feature was the entire absence of giant cells which one generally sees in the tissue surrounding any foreign body. From these findings we would conclude that the membrane is transformed into a fibrous tissue which covers the denuded bone and that a joint-like space is formed with fibrous walls similar in all respects to the walls of a cavity encysting a foreign body."

FIG. 4-A

Roentgenogram six weeks after arthroplasty demonstrating satisfactory mechanical reconstruction of head and neck of femur, but suspicious sequestration of the head, evidently due to disturbance of circulation at the time of operation.

FIG. 4-B

Same as Fig. 4-A, showing definite sequestration of the head of the femur.

FIG. 4-C

Same as Fig. 4-A, showing final extrusion of sequestrum with collapse of the joint and poor mechanical result.

MacAusland has had occasion to do secondary operations after arthroplasty of the elbow, and observed that "the bone ends are smooth and covered with a firm fibrous tissue; they fit snugly, yet move with a firm resistance. The joint space is a sac, sometimes multilocular, and contains an apparently normal joint fluid."

The author has operated on a number of patients in whom ankylosis has recurred after arthroplasty. In some cases there was a few degrees of motion. However, they demonstrated only fibrous or osseous ankylosis in which the interposed tissue and the remains of the remodeled articular surfaces had been obliterated. In consequence, no additional knowledge could be obtained.

Six joints have been incised after arthroplasty in which a practical range of motion with function had been attained. The indication for operation in each case was an unsatisfactory result which will be described separately. Five were on the knee and one on the hip.

CASE 5. Mrs. M. H., ankylosis of right knee, one year's duration. Arthroplasty was performed May 4, 1922; free motion was obtained, but there was considerable lateral instability, requiring a brace. Seventeen months after arthroplasty an operation for the purpose of increasing stability was carried out (October 17, 1923), which consisted of an inverted-U incision and shifting of the mesial and lateral ligaments to a lower attachment. On incision into the joint there was a definite cavity about two-thirds normal size, covered with a fibrous membrane. At the points of greatest pressure, this membrane was thin, and there was apparently a layer of cartilage. Sections were taken for biopsy, but unfortunately were lost in transmission to the laboratory. The operation was a total failure, the joint remaining as flail as before.

CASE 6. Mr. H. B., age twenty-eight years. There was a history of a progressive polyarticular arthritis of the ankylosing type, affecting both hips and the lower spine. The process had been apparently arrested for several years. Both hips were ankylosed in flexion of about 150 degrees. An arthroplasty was carried out upon the right hip on January 12, 1929, and on the left hip on March 12, 1929; about forty degrees of good function was secured in each hip, but in the left hip flexion recurred which, at operation, on November 26, 1929, was found to be caused by scar tissue in the region of the joint. This necessitated incision into the joint and removal of a portion of the capsule. On exposing the hip joint, there was found to be a definite joint space, with the acetabulum and the head of the femur much smaller than normal. The capsule was contracted over the joint to such an extent that there was no joint cavity over the neck as in a normal hip. The acetabulum and the head of the femur were covered by a dense bluish-white fibrous membrane. A small section was taken from the articular surface of the head. The bone was invested by tissue from about one to two millimeters in diameter. A microscopic examination of this section was made which demonstrated, under low power, that there were three more or less distinct layers, and in some places, four. The articular surface was covered by a dense layer of fibrous connective tissue which, in places, was absent—whether this might have been loosened in preparation could not be determined. The fibrous layer was continuous with the strata beneath which was about three times the thickness of the fibrous layer, and closely resembled fibrocartilaginous tissue. Beneath this layer there was cancellous bone. Between the bone and cartilage, fibrous connective tissue was observed in places and was continuous with the marrow cavities. Under the high power, the superficial layer was composed of dense fibrous connective tissue, the nuclei of which were flat. This tissue merged into the cartilaginous layer beneath. The outer portion of the cartilaginous layer was less cellular, consisting mainly of typical cartilage cells—some in groups of two to four daughter cells within one and the same

capsule. The remainder of the cartilaginous layer was quite cellular and was composed of an intermingling of connective-tissue fibers and metaplastic cartilage. There was no true cartilage matrix, but the once fibrous tissue had lost some of its fibrous connective-tissue characteristics and had become more homogenous in texture, taking a little of the basic stain. Next to the bone there was a narrow strip of dense cellular tissue, the nuclei of which were also flattened. This case is by no means a type best suited for study, but a report is made because it is the only hip with function on which the author has had the privilege of operating after arthroplasty.

CASE 7. Miss B. C., aged twenty-one years; acute infectious arthritis, solid bony ankylosis of left knee at an angle of 150 degrees. An arthroplasty was performed on left knee, November 22, 1926, with uneventful recovery. At the end of one year, the patient was able to walk without support and with very slight, if any, limp. Motion was present from 180 degrees extension to ninety degrees flexion; muscle power good; stability was also good, there being just slightly more lateral movement than in the

FIG. 5-A FIG. 5-B

Fig. 5-A. Anteroposterior roentgenogram of right knee showing definite joint space with smooth even joint surfaces; note condensation of bone beneath articulation and rearrangement of bone trabeculae. One condyle of the femur and one articular surface of tibia have been formed.

Fig. 5-B. Same as Fig. 5-A, lateral view.

normal knee. Patient complained of an indefinite catch in the joint which, at times, caused her to fall or her knee to give way. On December 8, 1927, an exploratory operation was carried out, as follows: An internal lateral incision was made into the left knee through the former operative scar. The skin and superficial fascia were found to be normal. The capsule and periarticular structures were much increased in thickness, possibly to about one inch. On passing through the capsule, a definite joint cavity about one-half the capacity of the normal knee was reached, which extended

FIG. 6

Anteroposterior roentgenogram illustrating sequestration and cavity formation on the lateral condyle of the femur, evidently caused by disturbance to the articulation at the time of operation. In this case, however, even in spite of this defect, there was excellent function, though such a complication might result in instability and deformity.

FIG. 7

Lateral roentgenogram of left knee eight years after arthroplasty, in which excellent functional result was obtained. Note fusion of the patella to the tibia which apparently increased stability of the joint and from the occurrence of which a new operation for the stabilization of the knee was devised, as described in Case 7. There are also proliferative changes indicative of a more extensive involvement of the bone at the time of the acute process.

between the articular surfaces of the tibia and femur, well under the patella and quadriceps tendon. A few adhesions were found between the quadriceps tendons and the posterior wall of the cavity, but these did not interfere in any way with movement. A very small amount of viscid joint fluid of a straw color was observed; this was less than is found in the normal joint but was sufficient for lubrication. The articular surfaces were smooth, glistening, regular, and covered with a dense layer of fibrous tissue, resembling in every detail the free transplant of fascia lata which was interposed at the original operation. A section was taken from the articular surface of the tibia and one from the lateral aspect of the joint cavity, including the capsule. Microscopic examination showed that the section from the articular surface was composed of three layers, superficial fibrous, atypical cartilage, and bone, which in detail closely resembled the findings in Case 6, except that the different strata were more clearly defined. The section from the lateral aspect demonstrated typical synovial villi, with a somewhat atypical endothelium; whether this was the remains of the former synovial membrane or a process of postoperative repair, could not be determined.

Case 8. Mrs. R. O. C. Acute pyogenic infection of the knee, January 1927. On examination, there was solid osseous ankylosis of the left knee, with approximately thirty degrees flexion. A routine arthroplasty was done October 27, 1927. The result as to motion was excellent, there being a range of 180 degrees extension to ninety degrees flexion; muscle power was excellent, but there developed lateral instability to such an extent as to require a hinged knee brace. Reconstruction operation for instability was performed March 8, 1929 (sixteen months after arthroplasty). A long mesial incision was made into the joint, extending well below and exposing the insertion of the patellar tendon. The joint cavity was about three inches in transverse diameter and about four inches longitudinally. The cavity extended well up beneath the quadriceps tendon, but not to the same degree as in a normal joint. The articular surfaces were covered with what appeared to be white fibrocartilage which, in places, was undergoing fibrillation or softening. There was considerable joint fluid. A small section was taken from the surface of the tibia, including about one-fourth of an inch of supporting osseous tissue, and also from the inner aspect, including the capsule. The lower third of the patella was denuded upon the posterior surface, and a similar area upon the upper anterior surface of the tibia. The patellar tendon was carefully detached and inserted at a much lower level on the tibia. The raw surface on the anterior surface of the patella was placed in apposition to a similar surface upon the tibia. The lateral ligaments were tightened by attaching them at a lower level. The functional result, after six months, was entirely successful, there being a range of seventy to 180 degrees of motion with excellent muscle power; so that the brace could be discarded. This type of operation was suggested by two arthroplasties, in which the patellae were fused unintentionally to the anterior aspect of the upper extremity of the tibia. In both cases the results were unusually excellent. The microscopic section of the articular surface was so nearly identical with those described above as to require no repetition. The section from the capsule demonstrated only fibrous tissue.

Case 9. E. H., age twenty-three years, male: Acute infectious arthritis of the left knee in 1925, followed by complete osseous ankylosis. The knee was in extension, with solid bony ankylosis between the femur and the tibia. An arthroplasty was performed June 7, 1927. The patient still continued to wear a brace and there was too much lateral play in the knee joint, although he had active motion with a fair degree of power from 180 degrees extension to ninety degrees flexion. On April 6, 1928 (ten months after arthroplasty), an incision was made into the joint for the purpose of correcting the increased laxity; a long piece of fascia lata was employed to reenforce the lateral ligaments. The joint cavity was approximately one-half the normal size. The articular surfaces were somewhat irregular and were covered by a bluish-white material which closely resembled articular cartilage. At this time a specimen was removed for microscopic study which, on examination, showed practically the same characteristics as in the cases described previously.

CASE 10. Mrs. E. C., acute pyogenic infection of the left knee in June 1919. On examination there was bony ankylosis of the joint with eighty degrees flexion, subluxation, and genu valgum. Arthroplasty was carried out on October 6, 1926. At the end of six months it was quite evident that the knee was unstable, but there was excellent function possible by the aid of a hinged knee brace. On June 23, 1928 (nineteen months after arthroplasty), a second operation was carried out, similar to that employed in Case 8, except that free fascia lata transplants were employed to reenforce the mesial and lateral ligaments; and also the articular surfaces were reshaped so as to attain a more even articulation. The routine long mesial incision was made into the joint; a synovial space was revealed about one and one-half inches in diameter; the articular surfaces were covered with dense fibrous tissue, all evidence of the fascia lata having entirely disappeared. Unfortunately, by some misunderstanding, the pathologist made a report as to diagnosis of tissue, without regard to structure. The final results of the reconstruction operation could not be determined on account of the fact that the patient was injured in an automobile wreck in which she sustained extensive lacerations of the muscles of the affected limb, but she states that the condition of the knee prior to this accident was satisfactory.

FIG. 8-A

Anteroposterior roentgenogram showing satisfactory arthroplasty of the wrist. Note joint space approximately the size of normal.

FIG. 8-B

Same as Fig. 8-A, lateral view.

Roentgenograms.—Much information can be secured by successive roentgenograms after arthroplasty. About 200 films of arthroplasties have been reviewed, ranging from one to ten years after operation. There are some variations in findings, depending upon the function of the joints in question. The evolution of functional adaptation, as would naturally be expected, is more pronounced in the knee and the hip than in the non-

weight-bearing joints. The dimension of the joint space is less than normal, especially in weight-bearing joints. The relation of the articular surfaces to each other remains unchanged, except in a small number in which the stamina of the ligaments was impaired and in those where gross irregularities had occurred. In a majority the contour of the articular surfaces was even and smooth; in some there was a definite irregularity. In a small number of knees there was a punched-out area or cavity on the lateral aspect of the articular surfaces of the femur corresponding to the normal external condyle. In two or three there were similar changes in the lateral half of the articular surfaces on the tuberosity of the tibia, but to a much less degree. Gross irregularities in the head of the femur were occasionally observed, and in one instance there was total disappearance of the head and neck. Compression of the articular surfaces was also present at times. The gross irregularities above described were probably due to impairment in circulation at the time of operation. Successive roentgenograms demonstrated compression of the articular surfaces to be due to functional use, as weight-bearing, before the structure of the bone had been sufficiently restored. In non-weight-bearing joints unrestricted use with impaired ligaments may also cause such irregularity, but not to the extent demonstrated in the lower extremities. These defects can be obviated largely by avoiding impairment of circulation at operation and properly regulated use and restricted weight-bearing until the structure of the bone and the musculature has been restored, as has been proven by experience.

The structural changes are quite evident. At the end of three weeks osteoporosis is present, as denoted by the characteristic mottling, which gradually increases until the effect of active use is apparent, which is usually about three months. At this time there is gradual restoration of structure as denoted by the reappearing of bone trabeculae. At the end of one year the bone structure should be approximately normal. About this time, approximately one-fourth of an inch below the articular surface, there appears a fine line of condensation with bone trabeculae at right angles to the shaft; this gradually increases for the ensuing year, after which it remains stationary. This is probably the index that restoration has been accomplished as far as possible. As years go by, the rearrangement of the osseous trabeculae, along the new lines of stress, becomes evident as in normal extremities. Of course, there is no arbitrary period for such development, which largely depends upon the cooperation and the muscular resources of the individual.

Pronounced bone proliferation, as evidenced by formation of outgrowth from the articular margins or osteophytes, was present in approximately forty per cent. In twenty-five per cent. there was only slight proliferation and in thirty-five per cent. no reaction whatsoever. This reaction depends entirely upon the extent and the degree of involvement of bone by a pyogenic process; in other words, on the degree of osteomyelitis, as evidenced by condensation of bone. In those patients in whom the infection was entirely confined to the joint, and the structures of the bone had

FIG. 9-A

Arthroplasty of left ankle, anteroposterior view. Note complete fusion of tarsus and metatarsus.

FIG. 9-B

Same as Fig. 9-A, lateral view.

remained normal, there was no reaction. This reaction, however, does not bear any material relation to the functional result, unless there has been an extensive osteomyelitis. In many apparently normal or serviceable joints, after various pathological processes, such changes are known to occur and are frequently observed.

The type of joint secured by arthroplasty decreases materially, or entirely eradicates, such defects as awkwardness, deformity, and limp, which may be apparent in an ankylosed joint; and also restores a practical range of efficient motion, which is not normal but a most excellent substitute.

On incision into the joint, the skin, superficial and deep fascia are normal. The joint capsule at the end of one year may be much thicker than normal; in Case 7 it was almost one inch in thickness. This, however, decreases as time ensues, but always remains greater than normal. The joint cavity is smaller, varying from one-third to one-half that of a normal joint. In two cases there were fibrous bands traversing the joint; in others no adhesions were present. In two instances there was evidence of separate bursae or hygromata. In all, except Case 6, there was present a joint fluid, the composition of which was not analyzed. Degenerative areas were apparent in two cases, evidently due to faulty mechanics. The fluid, in all probability, arises from connective-tissue spaces of the articular surfaces. The space between the articular surfaces usually is less than normal in the weight-bearing joints, and in the non-weight-bearing surfaces approximately normal or greater than normal. The joint cavity may be invested by a dense fibrous membrane which may closely resemble the transplanted fascia lata; or the articular surfaces are apparently of a cartilaginous nature, but do not possess the even, smooth, glistening appearance of hyaline cartilage. These changes depend, not so much on the period of time, as upon the functional use of the joint in question. The articular surfaces were fairly smooth, but rougher than normal and in some instances there

were irregularities,—as furrows, pits, and small eminences—but these were not sufficient to impair function. In Case 7, in which there was such slight impairment of function that the indications for secondary operation were questionable, the articular surfaces were even and smooth. However, it must be remembered, as previously stated, that there was some mechanical defect in all cases in which there was an opportunity for biopsy, but sufficient function to bring about evolutionary changes.

The roentgenogram defines the restoration of osseous structure and the physiologic rearrangement of trabeculae to conform to the lines of stress in the reconstructed joint. It was clearly demonstrated that the flattening of the articular surfaces was caused by too extensive functional use,—as weight-bearing in the presence of bone atrophy or osteoporosis. As previously stated, "function must be cultivated, but not coerced" is an axiom applicable to restoration of function after arthroplasty, as in many joint affections.

The stamina of the contour of the articular surfaces, as illustrated by the gross irregularities observed in the roentgenogram, is determined by the circulation which controls normal bone repair,—whatever theory may be accepted, cellular or physiochemical. The articular extremities being free, the blood supply is derived solely from the attachment of the adjacent soft structures. The joint surfaces do receive slight nourishment from the joint fluid, but not sufficient to have an appreciable effect. During operation, if there is gross detachment of the bone from the soft structures, circulation will be impaired and areas of the articular surfaces may undergo aseptic necrosis with sequestration or absorption; on the other hand, the soft structures may be reattached with reestablishment of the blood supply before such occurrences take place. There is a close analogy to the loose bodies in joints, the bone graft, and terminal fractures in extremities. The loose body, especially the type caused by the condition known as osteochondritis dissecans, is, in all probability, due to trauma impairing circulation to the arteria media in the posterior crucial ligament, which supplies a small area on the internal condyle of the femur. By aseptic necrosis a particle of bone with cartilaginous investment is exfoliated into the joint. A cross section of this body, after it has remained in the joint for a long period of time, will show living tissue on the exterior, but necrosis within, receiving nourishment only from the joint fluid. However, if by chance the loose body becomes attached to a villus or a fold in the synovial membrane, the particle becomes revascularized, there being more rapid proliferation and restoration of the interior. The bone graft also depends on early revascularization in the same manner, if function is to be restored. Terminal fractures often do not unite, as illustrated by the frequent occurrence of non-union in such locations as the neck of the femur and the external condyle of the humerus. This non-union is caused by the severance of the circulation by fracture and the fact that a large portion of the terminal fragment—the articular surface—is devoid of blood supply.

The gross irregularities after arthroplasty, demonstrated by the

FIG. 10-A

Arthroplasty of the elbow, demonstrating relations of bones and joint cavity.

FIG. 10-B

Same as Fig. 10-A, lateral view.

roentgenogram, are not always incompatible with excellent function, as often observed. Similar irregularities in joints of good function are demonstrable often,—for example, a large cavity may remain in the internal condyle of the femur without impairing function, after a loose body caused by osteochondritis dissecans has been removed; also it is possible that many of the irregularities observed in the roentgenogram may be filled in with dense fibrous tissue, the defect being more apparent than real. Unfortunately, no opportunity has been offered to prove, by biopsy, the status of such joints.

The tissue structure of a joint restored by arthroplasty, as demonstrated by microscopic examination, is almost identical to that in a spontaneous arthroplasty, a joint which has been destroyed by a pathological process, or pseudarthrosis. In these conditions there are three more or less well defined strata,—namely, from within outward, a dense fibrous layer, a stratum of atypical cartilage, and the supporting bone. The superficial fibrous layer is approximately from fifty to 100 microns in thickness; the fibrocartilaginous layer is approximately from 500 to 1,000 microns in thickness; the osseous layer is, of course, continuous with the osseous structure of the bones which comprise the articulation. The articular surfaces apparently

arise from two sources: the exposed marrow spaces and the transplanted fascia lata, if the latter remains viable; otherwise from the marrow alone. As cartilage cells have been demonstrated in the deeper layers of the synovia and capsule, it is possible that the articular surfaces could be derived from that source. However, the origin of at least the fibrocartilage is so evidently from the connective tissue of the marrow that conclusions are made that a large portion of the articular surface is from this source. The strata of the superficial fibrous layer and the fibrocartilage apparently become better defined as function in the reconstructed joint is restored. The period of time after arthroplasty in those cases in which the specimens were secured ranged from five to nineteen months. In Cases 7, 8, and 10, in which twelve, sixteen, and nineteen months, respectively, had elapsed after arthroplasty, the strata were much better defined. The evolution is influenced, however, more by increased function than by the elapse of time, and the ultimate organized articulation depends largely on the cooperation of the individual in the restoration of function.

The superficial fibrous layer is composed of dense, closely packed fibers, which run parallel to the articular surface; the cells are many with flattened nuclei. This dense fibrous layer is continuous with the capsule. There was no evidence of a cellular investment of the capsule, except in Case 7, in which definite villi with several layers of cells could be demonstrated. As previously stated, this may have been the remains of the former synovial membrane and cannot be accepted unequivocally until further evidence is submitted. In the other cases the dense fibrous layer invested the capsule without evidence of an endothelial lining. Beneath the superficial fibrous layer there is found the stratum of cartilage, which is atypical and may be regarded as metaplastic. The typical cartilage cells, in groups of two or more daughter cells in one capsule, are observed just beneath the fibrous layer near the surface; the other portion of this layer is composed of many undeveloped

FIG. 11

Photomicrograph of section taken from the lateral aspect of the capsule of a knee joint of Case 7, Fig. 14, showing synovial villus. Whether this is the remains of normal synovial membrane or reconstructed by nature after arthroplasty cannot be determined. In no other case was such a condition observed.

cartilage cells and connective-tissue fibers. No true cartilage matrix could be demonstrated, but the fibrous tissue was more homogeneous in texture, taking a little of the basic stain, and thus resembling cartilage. If we assume that the first layer described is an attempt at formation of perichondrium, the remainder of the histologic picture is directly opposite to that seen in the normal investing articular cartilage,—by which is meant that the daughter cells are nearer the surface after arthroplasty, whereas, under normal circumstances, they are in the deeper layers nearer the bone. (However, this may be viewed in the light of nature's evolutionary process of repair which, by functional use, will in time approach normal arrangement of adult cartilage.) The osseous layer is continuous with the remainder of the bone which enters into the formation of the articulation, the roentgenogram clearly demonstrating the structural restoration by functional adaptation.

From the occurrence of this dense fibrous investment in "spontaneous arthroplasties" and pseudarthrosis in which no tissue was interposed, the rôle of the fascia lata may be questioned. Whether this fascia lata lives and acts as a permanent investment membrane, is absorbed and a new stratum of fibrous tissue developed, or the fascia itself acts as a scaffold or net framework and is gradually substituted, or—as Baer suggests—is incysted as a foreign body, is a question to be solved by the physiologist and histologist. However, practical experience has proven that the fascia lata does possess a definite action conducive to the development of a joint. In a large percentage of successful arthroplasties, the fascia lata probably remains viable, as the tissue is in close approximation to the new osseous surface of cavernous bone and surrounding soft structures, from which revascularization is quite accessible. It is also doubtful if an inert substance would stand the strain of early functional use routinely required. The characteristic of the fascia, however, is affected by function after an elapse of time, as are all tissues under normal conditions.

COMMENT

The title "Physiology of Arthroplasty" may be somewhat ambiguous, as the term arthroplasty implies merely the operation, but it is sufficient to convey the scope of this discussion to those interested in the subject. Restoration of function to the joint is accomplished by a long continued evolutionary process of functional adaptation induced by systematic treatment subsequent to the complicated operative procedure. Due emphasis must be placed upon the fact that arthroplasty is not the induction of pseudarthrosis, but the mechanical reconstruction after ankylosis of all of the component parts of the joint to restore function. The details of the technique, indications, subsequent after-treatment, and results in various joints from which conclusions have been derived for this discourse, have been fully described in former publications. These differ, as do the mechanics of various joints, but in general the principles of the procedure

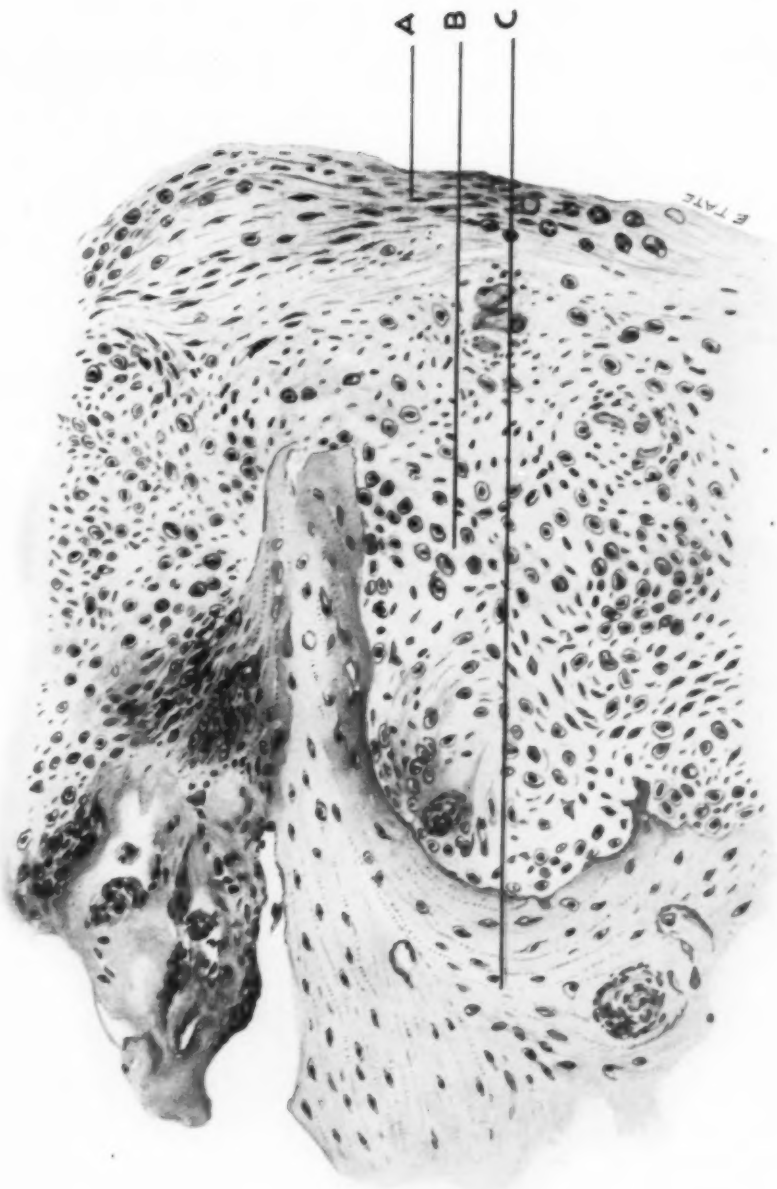

PLATE III

Section from hip seven months after arthroplasty. About thirty degrees motion was present with good function. Note formation of three layers of tissue: (*A*) superficial fibrous layer beneath which are (*B*) metaplastic cartilage and (*C*) bone. The cartilage is proliferating, as demonstrated by the daughter cells which are present in the most superficial layer. This observation is quite different from the development of normal cartilage. In normal conditions proliferation occurs in the deep layer of cartilage nearer the bone.

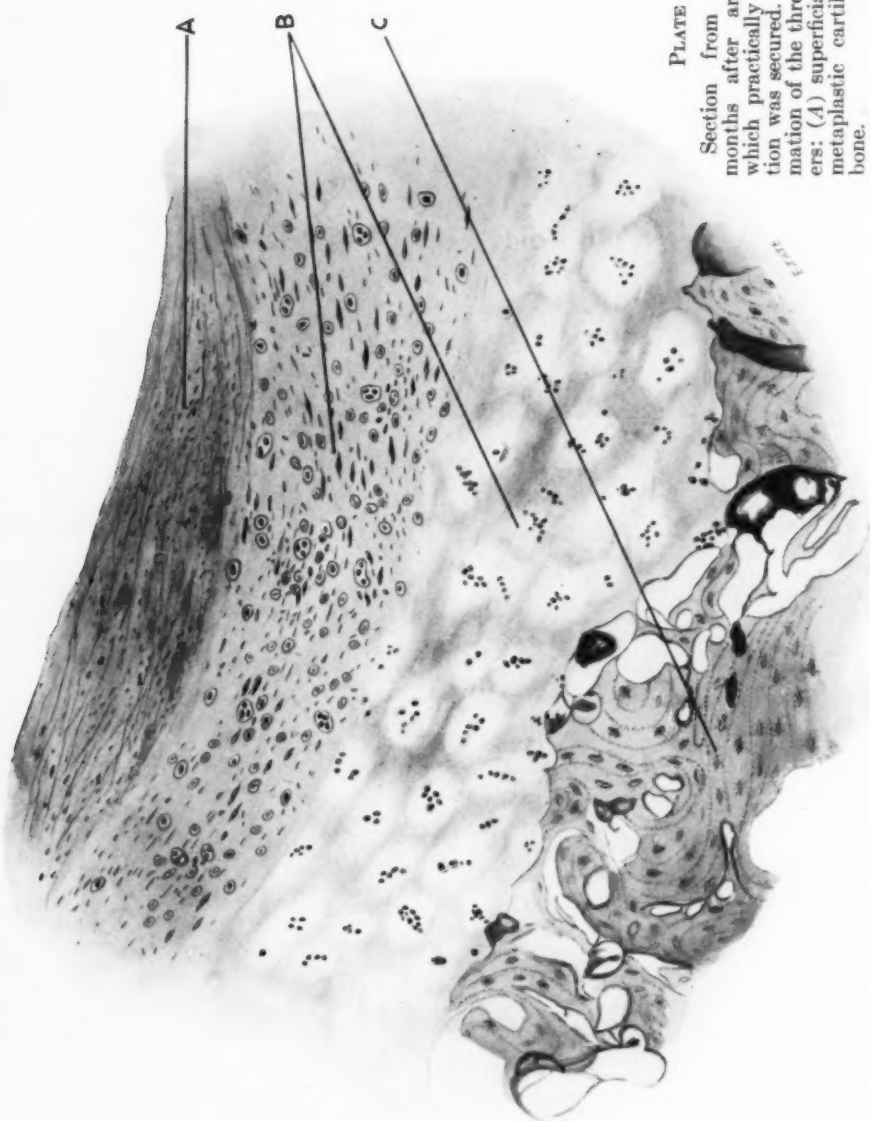

PLATE IV

Section from knee twelve months after arthroplasty in which practically normal function was secured. Note the formation of the three definite layers: (*A*) superficial fibrous, (*B*) metaplastic cartilage, and (*C*) bone.

are the same in all and may be divided as follows: (1) the plastic adjustment of the soft tissues; (2) the reconstruction of the bones; (3) the interposition of some material between the articular surfaces.

After arthroplasty a joint is developed in which function to a practical degree is restored; there is a definite joint cavity with a lubricating fluid. This cavity, including the articular surface, is invested by a stratum of fibrous tissue which may in time, by functional adaptation, be supplanted by cartilage. However, by observation of joints evolved by spontaneous arthroplasty that has existed for many years, it has been demonstrated that this fibrous investment or fibrocartilage is permanent; therefore, it is natural to assume that a similar condition will remain indefinitely after arthroplasty. The stratum of cartilage will probably develop into a more mature type of fibrocartilage, but never the typical articular hyaline cartilage of a normal joint. The structure of the bone conforms to the lines of stress produced by function of the new joint, as illustrated by the roentgenogram.

The evolution of the reconstructed joint by arthroplasty is nature's method of repair, which is so directed by the operation; and is exactly the same process as occurs by motion or friction of raw osseous surfaces in ununited fractures and spontaneous arthroplasties, after destructive lesions of joints. In other words, this is nature's manner of reconstructing a new joint by the normal process of repair in adult tissue. With rare exceptions, a gross defect from a destructive process or trauma is repaired by the same type of tissue as that of which the organ is composed. Therefore, we could not assume or expect a process of repair in a joint to differ from that of other parts of the body. Living tissue cannot be regarded as an inanimate object which can be molded or made into various shapes as may be desired without due regard to the physiologic reaction of the organism.

SPECIFIC VACCINE TREATMENT OF ONE THOUSAND CASES OF CHRONIC ARTHRITIS, WITH RESULTS AND CLINICAL OBSERVATIONS

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This report covers the treatment of 1,016 cases of chronic arthritis, 726 being of two or more years' duration. Tubercular, gonorrhoeal, and luetic joints are not considered at all in this article.

Of the total number, 304 are classified as severe, 386 as moderately severe, and 326 as mild cases. All cases have been under observation during a period of from one to seven years. Of these, 431 are still under treatment.

Information has been received concerning the present condition of 200 of those not under treatment at the present time. This was obtained from questionnaires and, in a few incidences, from visits or word sent in by some other patient. Of these 200 cases, 100 are reported as being in the same condition as when treatment was stopped, fifty are reported as worse, and fifty as having improved after cessation of treatment. From these figures, we believe that it is fair to record the present condition of the 385 patients not heard from as averaging the same as when last seen. This last group includes most of the patients treated years ago, and will be considered in more detail when results and types of treatment are discussed. The entire group was treated with vaccine. This was prepared by the method previously described[1].

CAUSE OF ARTHRITIS

Before entering into the discussion of treatment, we would like to state that we believe chronic arthritis is an infectious disease. We do not feel that there has been positive proof that any organism except streptococcus can cause it. To support the belief that streptococci do cause arthritis, there is the experimental proof in rabbits [2, 3, 4, 5, 6], there are positive streptococcus blood cultures in varying numbers of cases of arthritis [7, 6], streptococcus cultures from glands taken from the vicinity of inflamed joints [8], and instances of streptococci isolated from joints and joint fluid.

Regarding staphylococci, we do not believe that there is proof so convincing as that incriminating streptococci, but we must admit that positive staphylococcus complement fixations are frequent, and that most of our patients receive some staphylococci in their vaccine. Other organisms that are regarded as being capable of causing arthritis we classify with amoebae and typhoid,—that is, organisms that injure a protective wall (the intestine in this instance) and give the streptococci which are present a chance to cause their own infection. In this way amoebae allow streptococcal absorption and are blamed for their sins.

Most of our patients want to know what their infection "comes

from". In most severe cases of arthritis of two or more years' duration, the sequence is fairly typical. The onset may have manifested itself primarily in the joints or as some acute illness,—generally an upper respiratory tract infection with subsequent joint involvement. If the joint lesions are primary, there usually will be found some more or less obscure active focus, removal of which may bring about temporary relief, no material change, or an exacerbation. The arthritic manifestations usually become progressively worse even though the patient may appear to be harboring no more active infection than the average normal individual.

We believe that most arthritics have a basic susceptibility to streptococcal infection or they would recover without residual joint involvement, as do most people with acute infections without such basic susceptibility. There must be either an overwhelming infection or a markedly lowered resistance at the onset to allow the infection to become systemic instead of local and to allow the infection to be disseminated by the blood stream [6, 7, 9, 10].

During the chronic progressive stage of the disease an active joint may be a seat of absorption and dissemination of organisms, and we find a streptococcus infested colon always present. This colonic flora we believe to be of great importance, as ninety per cent. of our blood and joint culture strains are of the infrequens and faecalis types according to Holman's classification, and such organisms have given low grade chronic arthritis without pus formation when injected into rabbits[10].

All cases of chronic arthritis do not present a clear picture of infection either at the onset or during the course of the disease, but we believe that there is sufficient evidence of streptococcic culpability in all types to warrant considering both the atrophic and the hypertrophic infective. Clear-cut cases of all types have been produced experimentally in rabbits, and in the human the charts will demonstrate that the vaccine treatment shows no favorites, both types making adequate response to treatment in a majority of cases.

Interference with circulation may unquestionably result in altered density and even an overgrowth of bone. This has been demonstrated experimentally[11] and has of course long been noted in the phalanges of patients suffering from prolonged cardiac decompensation and pulmonary tuberculosis, mainly conditions that interfere with proper oxygenation of venous blood. These conditions do not resemble the so called degenerative type of arthritis in that they are practically painless and without material limitation of mobility. Consequently, we do not believe that circulatory inefficiency can be a primary cause of degenerative arthritis, and we are particularly convinced of this because treatment according to our usual regime, including of course vaccine therapy, has given a higher percentage of marked improvement in this type of case than in any other. These osteo-arthritic patients may have joint motion restored to full normal range and be entirely relieved from pain without any apparent diminution of spur formation as demonstrated by roentgenograms.

We have always felt that in the majority of these cases the inflammatory process and not the bony overgrowth is responsible for the pain, and consequently for much of the limited mobility.

EXAMINATION OF PATIENT

When a patient is first seen, a complete history is taken, the joints are examined, and a thorough search is made for foci of infection. If unusual examinations are indicated, the patient is referred to a specialist in that particular field. Cultures are taken from the teeth, gums, throat, upper nares, and stool routinely. If there are other suspected foci, they are also cultured. We obtain streptococci of some kind from the gums, throat, and stool in practically one hundred per cent. of cases. Staphylococcus aureus and streptococcus are the common growths in the upper nares, though occasionally we obtain staphylococcus albus or hemolyzing staphylococcus aureus or albus. Six to eight cubic centimeters of blood are also taken at this time, and are used for complement fixations with about thirty strains of streptococci obtained whenever possible from proven foci in arthritic patients. This specimen is also tested for gonococcus, staphylococcus, and bacillus coli fixations, and a Wassermann test is made[12].

From the autogenous cultures, the streptococci and staphylococci are isolated and killed with phenol, one-half of one per cent. in normal saline. Usually there are several focal strains that have given positive complement fixations with the serum of the patient, and these are added to the vaccine. The vaccine thus includes each patient's own organisms plus a varying number of focal strains.

The active serum complement fixation seems to be the most convenient and specific test we have. It usually corresponds with agglutination and skin tests, and obviates the chief disadvantage of the skin test,—namely, the difficulty of making thirty or forty scarifications on each patient. An added advantage of the active serum complement fixation is that the complement must first be titrated, and we are able to gage the amount of complement, or basic non-specific resistance to infection mathematically, for if complement is very weak, or apparently absent, we have found that vaccine is not tolerated in even the smallest doses, and vaccine therapy is contra-indicated until an adequate complementary titre can be restored[13].

GENERAL TREATMENT

On the second visit, one week later, when the examinations and cultures are finished, the patient is given individual instructions to suit his particular case and the vaccine treatment is started if indicated. The examination of the faeces has given us information as to digestion, fermentation, mucus, and intestinal flora. The urine gives data as to absorption of putrefactive products, condition of the kidneys, water intake, crystals present, etc., and the diet is restricted or amplified according to the needs

of the case. Sweets are routinely restricted as they form too good a medium for growth of the intestinal streptococci. The pure starches are frequently cut down even though there be no definite starch indigestion or carbohydrate fermentation, because most people eat starches to excess. The undigested starches and consequent fermentation products make easy the life of the ever present intestinal streptococci. If the patient is run down or underweight a liberal diet is allowed as we feel he needs food to build up resistance, but if starch indigestion is present taka-diastase or some similar product is given to promote its more complete assimilation.

Meat is ordinarily restricted but is not taboo. The daily portion is frequently reduced to not more than the size of a lamb chop of any kind of meat, poultry, or fish, particularly if there is a high putrefactive flora or a markedly high indican. When the blood chemistry shows the need of it, the protein intake is of course always reduced. Nucleoproteins are usually restricted. Oxalic-acid-bearing fruits and vegetables are cut from the diet despite the fact that most of them are vitamin containers, as we wish to avoid extraction of calcium and production of excess calcium oxalate crystals. Excess salt, condiments, spices, and irritating food and drink of all sorts are forbidden because their action on the mucous membrane allows more permeability and consequently greater absorption of streptococci. An attempt is usually made to implant bacillus acidophilus so as to give the patient the advantage of the most favorable intestinal flora, but the average intestinal antiseptic leaves much to be desired.

If relief is obtained from any of the various forms of physiotherapy we advise continuation of the treatment, but most of the patients are advised to treat their joints at home by means of compresses, lamps, counterirritants, and such simple remedies as are found to give temporary palliation. The chronic patient usually has a fairly thorough knowledge of the usual home remedies and also a decided opinion as to which procedures are beneficial and which of no value. Most of our patients are likewise conversant with most of the so called anti-rheumatic medications, and have fixed ideas as to which ones are of benefit. They are permitted to use the preparation that is of greatest service in most instances but habit forming drugs such as morphin or codein are not allowed.

An attempt is made to combat constipation, and we feel that the patient should have one or two full free movements a day without either bowel irritation or diarrhoea. When necessary, colonic irrigations with bicarbonate of soda are ordered. Carbonate of soda is scrupulously avoided because of its action inhibiting the growth of colon bacilli and favoring free multiplication of streptococci[10].

Glandular preparations are used more or less experimentally. Leaders in the field of gynecology and obstetrics place very little faith in ovarian and luteum preparations, and we have seen none of them do any good whatsoever. We believe that the menopause may have considerable influence in the time of onset of arthritis, but feel that this influence is nonspecific and due to a general lowering of resistance and functional activity

during that period. One important fact that we can explain only theoretically is that during pregnancy many arthritics clear up entirely, only to relapse suddenly in from two to six weeks after term. Our explanation is that all glandular and functional activity is increased during the period of pregnancy, and consequently resistance to bacterial invasion is likewise increased. After childbirth, this stimulation passes over to a period of depression and the bacteria again have more easy access to the systemic circulation.

Thyroid is used as indicated, but with no direct influence on the joints. Its use increases complement and consequently resistance to infection in the patient who has a low basal metabolism. Thyroid and vaccine are in our experience synergistic, and when used together, both must be given cautiously. As a measure to increase comfort and a later usefulness of affected joints, orthopaedic measures must of course be given full consideration.

VACCINE TREATMENT

The vaccine is given once a week, as an intramuscular injection. We are in entire accord with Warren Crowe in the consideration of dosage.

Toxic cases are given an initial dose of five thousand organisms. If there is a reaction, this dose is cut down to one-tenth, or to five hundred organisms. In rare cases this is again diminished to fifty organisms. Even when a patient is doing well, the dose is frequently not increased. In the less toxic cases, fifty to five hundred thousand organisms are given in the original injection.

In every case a reaction is followed by a reduced dose, unless it be a transitory increase in pain followed by marked remission. This we consider favorable. Protracted increase of pain is avoided whenever possible. General reactions with grippy pains, headache, malaise, increased heart rate, slight temperature, and loss of weight are always to be sedulously avoided. Our dosage is too small to give foreign protein reactions.

If a patient is not having reactions, but is showing no improvement after two or more months of treatment, the case is rechecked, and if unchanged the dose is diminished.

We believe that we are dealing with as close an approach as possible to a specific vaccine, and that it does not necessarily build antibodies, but rather desensitizes the patient. To support this opinion there are two facts,—the reaction dose compares in strength with reaction doses of other desensitizing vaccines; also, the complement fixations are negative after successful treatment.

In cases where the complementary titre is very low, vaccine is not given, as the patients steadily become worse, even on the small doses. In place of vaccine, general upbuilding measures are the most useful aids in treatment, and by them we are able to build up complement in most cases. A specific streptococcic toxin is used in these cases, with beneficial results symptomatically in over sixty per cent. Toxin injections, however, seem

to increase pain in patients having a strong complement. Lack of complement is found in about three per cent. of all cases examined. Certain rare cases with good complementary titre become progressively worse, and vaccine, even in most minute doses, seems to increase rather than decrease symptoms. Such patients usually have an obscure, active focus of infection, and make favorable response only after the focus is eradicated or drained.

When this attempt to give specific vaccine therapy was inaugurated, the initial dose in all cases was five million organisms; a dosage which at that time was considered to be minute. After two or three months most patients became accustomed to this dose and started to improve. Some did not fare so well. To illustrate this, the percentage of "unimproved" or "worse" patients during the earlier years was ten and one-tenth compared with six in more recent times. The "slightly improved" cases then numbered fourteen and one-tenth per cent. as compared with the recent eight and eight-tenths. Besides the better results, the patients are no longer required to suffer such severe reactions as formerly.

The vaccine injections are continued at weekly intervals until the patients are practically free from symptoms. The interval is then gradually lengthened as much as possible. Some of the severe chronic cases require injections every week or two for years. If they go without for a longer interval, the former symptoms slowly return. Many cases clear up entirely and require no more treatment. Most of those we see fall into an intervening class. They require some treatment at varying intervals in order to keep symptom-free or even comfortable, and we like to see such patients every few months in order to avert recurrences.

It is rare to have a patient show material improvement in less than four to six injections, even though some cases may respond spectacularly. In arthritis of long standing it is well to warn the patient that the treatment is a protracted one, and with the severe so called arthritis deformans we invariably advise continuation of the treatment for at least a year without expecting a marked change for the better.

In the following tables there are fifty-nine patients listed as symptom-free who are still under treatment. These are symptom-free only when they take care of themselves, and when they are treated by us occasionally. An injection of vaccine acts like a combination tonic and analgesic and frequently holds them for several months at a time.

RESULTS OF TREATMENT

Before giving figures, we will describe the terms used. The cases were classified as to severity,—severe, moderately severe, and mild. The clinical type and serological type classifications were combined. The pure arthritis deformans, rheumatoid arthritis, and muscular arthritis are called pure (H) hemolytic types, because of the cultural and complement fixation findings. The pure osteo-arthritic type is called (V) viridans for

the same reason. If the types are mixed (as most are in the chronic stage) they are called (H/V) hemolytic over viridans, hemolytic predominating, (H = V) hemolytic equals viridans, if both are of equal severity, or (V/H), viridans over hemolytic if viridans predominates.

We use this serological and bacteriological classification based on a study of six thousand fixations[1] for our own convenience, and find it less cumbersome and more accurate in our work than the clinical, but we always keep in mind the standard forms of classification. The results from vaccine therapy show about the same percentage of improvement in all types of arthritis, so we do not consider clinical classification particularly important in determining treatment procedure.

Results are listed as (W) worse, (U) unimproved, (I) slightly improved, (M.I.) moderately improved, (V.M.I.) very markedly improved, and (S.F.) symptom-free.

Most of the worse or unimproved patients had improved in general health, but not in joint symptoms. No cases which were worse or unimproved after less than twelve injections were included in this list, as we do not believe that any treatment has been given a fair trial if such a disease as chronic arthritis of several years' duration is expected to clear up in three months' treatment. All men who have used vaccine extensively agree with us on this point.

Of the total number tabulated, seven and five-tenths per cent. were worse or unimproved, ten and seven-tenths per cent. slightly improved, eight and five-tenths per cent. moderately improved, fifty-six and six-tenths per cent. very markedly improved, and sixteen and seven-tenths per cent. symptom-free. As noted before, the improvement has been greater since the vaccine has been reduced to the present minute dosage.

There is a wealth of information in the tables which requires considerable time and study to bring out, but there are a few points that should attract attention at a glance.

Of the unimproved or worse patients, fourteen and five-tenths per cent. were of less than two years' duration; of those symptom-free, forty-five and four-tenths per cent. fall in the same time group; and twenty-three and five-tenths per cent. of the latter were afflicted less than a year when our treatment was started.

Of the unimproved or worse patients, fourteen and four-tenths per cent. were of pure hemolytic type; of those symptom-free, twenty-eight and two-tenths per cent. were pure hemolytic.

Of those unimproved or worse, fifty-four per cent. were severe cases; of those symptom-free, fifteen and three-tenths per cent. Of the former the disease in twelve and two-tenths per cent. was of less than two years' duration; of the latter or symptom-free cases fifty per cent. had been affiicted less than two years.

Of those very markedly improved or symptom-free, seventy-eight and six-tenths per cent. were of the pure hemolytic, seventy-four and seven-tenths per cent. of the hemolytic more than viridans, forty-five and four-

TABLE I

Results in different types of cases,—foci present. Foci removed prior to vaccine treatment, and foci removed during treatment.

Results	Totals	Severe Cases		Moderately Severe Cases		Mild Cases		Tonsils out	Teeth out	Tonsils infected	Teeth infected	Throat infected	Other foci present	Tonsils removed later	Teeth removed later
		Still under treatment	Not under treatment	Still under treatment	Not under treatment	Still under treatment	Not under treatment								
Worse	21	6	6		6		3	10	5	5	6	10		1	
Unimproved	55	5	24	5	9	1	11	37	23	5	14	22	1		3
Slightly improved	109	31	20	7	25	5	21	53	45	21	50	56	4	3	7
Markedly improved	86	16	16	12	11	7	24	47	27	14	22	45	3	2	6
Very markedly improved	575	86	68	109	124	82	106	253	191	103	145	295	31	13	27
Symptom-free	170	15	11	27	51	17	49	65	59	39	35	93	5	9	9
Total	1016	159	145	160	226	112	214	465	350	187	272	521	44	28	52

TABLE II

Comparison of results in age, clinical, and serological groups.

RESULTS	AGE INCIDENCE				CLINICAL AND SEROLOGICAL CLASSIFICATION					TOTALS
	20—	20–40	40–60	60+	Hemolytic	Hemolytic over viridans	Hemolytic equals viridans	Viridans over hemolytic	Viridans	
Worse			14	7		17		4		21
Unimproved	3	12	25	15	11	32	2	8	2	55
Slightly improved	2	25	53	29	16	54	6	31	2	109
Markedly improved	1	15	46	24	7	49	4	19	7	86
Very markedly improved	9	89	354	123	78	326	6	127	38	575
Symptom-free	3	49	95	23	47	83	4	30	6	170
Total	18	190	587	221	159	561	22	219	55	1016

TABLE III

Relation of results to duration, and to severity of disease.

RESULTS	TOTALS	DURATION BEFORE VACCINE TREATMENT WAS STARTED											
		LESS THAN ONE YEAR			ONE TO TWO YEARS			TWO TO TEN YEARS			OVER TEN YEARS		
		Severe cases	Moderately severe cases	Mild cases	Severe cases	Moderately severe cases	Mild cases	Severe cases	Moderately severe cases	Mild cases	Severe cases	Moderately severe cases	Mild cases
Worse	21	1		1	1			7	3	1	3	3	1
Unimproved	55	2	1		1	3	1	16	8	7	10	2	4
Slightly improved	109	3	2	2	8	3	2	31	16	15	9	11	7
Moderately improved	86	3	2	1	3	2	6	23	17	12	3	2	12
Very markedly improved	575	18	36	28	16	30	34	76	113	87	44	53	39
Symptom-free	170	9	24	17	4	9	14	8	35	28	5	10	7
Total	1016	36	65	49	33	47	57	161	192	150	74	81	70

tenths per cent. of the hemolytic and viridans equally, seventy-one and seven-tenths per cent. of the viridans more than hemolytic, and eighty per cent. of the pure viridans groups. Corresponding figures for unimproved and worse patients were six and nine-tenths per cent., ten and five-tenths per cent., nine per cent., five and five-tenths per cent., and three and six-tenths per cent. It may be seen that there is little difference as regards response to treatment among the different groups, whether considered clinically or serologically.

As to age incidence, the most prominent fact is that the very markedly improved cases between the ages of forty and sixty are about ten per cent. higher than the same age group in the other result columns.

In view of the fact that such cases of Stills' disease and rheumatic fever as have been treated by us have in the main made satisfactory progress, it seems highly probable that cautious specific vaccine therapy would be a favorable method of treatment not only for relief of symptoms but also as a means of warding off recurrences.

CONSIDERATION OF FOCI

Of all the cases tabulated, 465 had had their tonsils removed. Sixty-one and eight-tenths per cent. of those unimproved or worse and forty-two and eight-tenths per cent. of those very markedly improved or symptom-free had had one or more tonsillectomies. In spite of the large number of tonsillectomies, 521 patients still had definitely infected throats when first examined and 187 had infected tonsils which in twenty-eight cases had to be removed later. Fewer patients had had infected teeth removed than had tonsils out before treatment started.

We believe that tonsils should rarely be removed in an active case of arthritis until that patient has had a series of vaccine injections to ward off the possibility of the acute exacerbation that may follow a tonsillectomy. The injections should be resumed two weeks after the operation. This procedure is advised despite the fact that a majority of patients temporarily improve when infected tonsils are enucleated. In cases with low resistance, tonsillectomy without immunization sometimes causes serious exacerbations and makes us advise conservative treatment first, but if vaccine is of no avail, or if the improvement is not progressive, we feel that tonsillectomy should be performed. We believe other deep seated, active foci should also be treated in the same conservative manner.

An infected tooth may usually be removed at any time, because of the comparative simplicity of the operation. If there are several teeth with actively abscessed roots, we recommend the extraction of one or two at a time, always culturing the teeth and saving the organisms to be used for vaccine when necessary.

SUMMARY AND CONCLUSIONS

In view of the fact that a majority of the cases reported are patients who have suffered from arthritis for years, with either only temporary relief or no palliation whatever from general forms of treatment such as physio-

therapy, diet, purgatives, splints, removal of foci, etc., we feel the tables demonstrate that vaccine has a real value in the treatment of chronic non-specific arthritis of every clinical form.

If patients' complements were titrated to determine vaccine tolerance, and if the dosage were decreased instead of increased every time there is any indication of an unfavorable reaction, vaccine would stand in much higher favor than at present.

We believe that the vaccine must be as nearly specific as possible, and we use individual ones made up of all the evident autogenous focal strains plus whatever complement-fixing strains are found positive in the patient under treatment. We do not believe one single strain of streptococcus or of any other organism is causative of arthritis, but feel that streptococci of several types, mostly of the infrequens and faecalis groups, are the major offenders in the production of this disease.

We have no criticism of agglutination or skin tests in determining the type of infection, but feel that both these methods fail to give a titration of the patient's complement and we consider the complement fixation reactions more convenient and specific.

All possible methods must be used to build up the patient. Arthritis is a systemic disease and must be treated as such. If every tolerant case of active arthritis were treated with a proper vaccine properly administered at onset of symptoms, there would be much less disability and suffering from this most widespread disease. Arthritis is not the hopeless disease so many of the profession have pictured it to be. On the contrary, it can be controlled and relieved more completely than most chronic diseases.

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STYLOID PROCESS OF THE FIBULA IN THE KNEE JOINT WITH PERONEAL PALSY

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The syndrome of subluxation of the elbow, displacement of the internal epicondyle into the joint and ulnar palsy, is well known. Recently we recorded eight cases[1], and it was shown that the presence of the internal epicondyle between the humerus and the ulna was proof itself of an antecedent valgus strain accounting for stretching and paralysis of the ulnar nerve. So far as can be determined, no case has been recorded of an exactly analogous syndrome in the knee joint.

The case here reported was of a male, aged fifty-six, who was knocked down by a motor car. The knee joint was distended with fluid; there was undue lateral mobility and tenderness over the outer side of the joint. X-rays showed avulsion of the styloid process of the fibula (Fig. 1), and at operation the capsule was found coiled up and

FIG. 1

Avulsion of the external lateral ligament with the styloid process of the fibula. The ligament and capsule were displaced with the fragment of bone into the outer part of the knee joint, and there was associated paralysis of the external popliteal nerve due to traction.

FIG. 2

Case of displacement of the internal epicondylar epiphysis into the elbow joint with ulnar paralysis, for comparison with Fig. 1.

FIG. 3

Same case as Fig. 1, after operative replacement and suture with braided silk.

nipped in the outer part of the joint between the femur and the tibia. On hooking the capsule out, the styloid fragment appeared, still attached to the external lateral ligament and part of the biceps tendon. There was also clinical evidence of an incomplete paralysis of the external popliteal nerve; the nerve trunk was exposed at operation and found not to have been ruptured although recent hemorrhage into the sheath was evident. The styloid fragment was replaced and sutured with braided silk, and ten weeks later, when the plaster was removed, the paralysis had completely disappeared (Fig. 3).

Three features of interest are presented in this case. Although crack fractures of the upper end of the fibula are not uncommon, complete avulsion with wide separation is rare, because the fellow limb protects the knee joint from severe varus strains. The exact mechanism of injury is unknown in this patient, but in another recent case force was transmitted through one knee to the other. While standing with his knees in contact, the patient was struck by the bumpers of a car on the outer side of the right knee. He sustained on the right side avulsion of the internal lateral ligament with a fragment of bone from the femur, and on the left side avulsion of the external lateral ligament with a fragment of bone from the fibula. Secondly, complete recovery of peroneal palsy is unusual; but as a rule the nerve is injured by contusion, whereas in this case the block has been purely "physiological" and it is attributable to momentary stretching of the nerve trunk. Finally, the close resemblance between the clinical syndromes in knee and elbow is remarkable (Fig. 2). In each condition, in consequence of a lateral strain there is subluxation of the joint, avulsion of capsule, and aponeurosis with an attached fragment of bone, displacement of the fragment into the joint, and coincident traction injury of a nerve.

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THE INTERNAL FIXATION OF FRACTURES

BY H. R. CONN, M.D., F.A.C.S., AKRON, OHIO

A series of unhappy experiences with fractures of the lower third of the leg is responsible for the presentation here of a new fixation instrument. The Steinmann pin had yielded an alarming number of patients with non-union and the Lane plate was regarded with distinct distaste. The writer believed that an ideal fixation device should assure: absolute control of the fragments over a sufficient period for union to begin, ease of primary application and removal without anaesthesia or secondary opening of the wound, the imposition of a minimum amount of foreign material upon traumatized and devitalized tissue, and preservation of the periosteum at the site of fracture as essential to early union and protection against infection.

The ancient instruments of Lambotte and Parkhill, now fallen into disuse, seemed to have possessed many of these necessary virtues, but the literature dealing with their development and use contained little of unprejudiced experience.

Historically we are surprised that throughout the ages in which homely surgery has been practiced, the first written account of an attempt at internal fixation is reported by Guthrie who credits Lapeyode and Sicre with using wire in 1775. Malgaigne in his treatise on fractures published in 1847, described a metallic *griffe* or claw-like device which he used with success for fracture of the patella. Five years later Chassin proposed a modified Malgaigne claw for fractures of the clavicle. Both instruments were apparently widely used by many writers of the period, although case reports are meager. Rigaud, in 1867, quoted Gaujot as describing the instrument of Vallete, a further modification of Malgaigne's original idea. All were claw-like instruments with sharp points, intended to be pressed through the skin into the bone fragments, a degree of reduction and fixation to be obtained by bending the connecting bar between the claw-like ends.

Bérenger-Féraud, in 1870, credited Rigaud with having first implanted screws of Swedish iron into the ulna for fracture of the olecranon. Reduction was apparently secured by tying the screws together with twine. Bonnet modified Rigaud's procedure by rendering the screws solid with a small metallic bar. Bérenger-Féraud himself used screws and a wooden bar.

Lambotte, in 1907, described the implantation of metal screws through the diameter of the long bones, fixing the protruding pins in a metallic plate. In his report he asserts that he has used the device freely since 1900. Parkhill somewhat modified the simple bar used by Lambotte and claimed 100 per cent. perfect results as compared to fifty-six per cent. by all other mechanical means. The article is indefinite as to exactly what is meant by

"other mechanical means". Despite the early mention of transfixion pins, immobilized with an external bar, by Rigaud and Bonnet, the method fell into disuse, undoubtedly because of the uncertain operative technique of the seventies. Lambotte and Parkhill, who championed the method after 1900, obtained a greater success and their names are indelibly associated with external bone clamps.

The writer early entertained the idea—now proven correct—that the disuse of the external clamp and buried pins was not so much the result of error of sound principle as of premature loosening and consequent loss of fixation. Specifically it was felt that this was due to an improperly designed pin of corrosive metal. To avoid corrosion, the pins were fashioned of stainless steel which, except for a treacherous brittleness in the first alloy employed, has proved satisfactory. More important, as regards pressure necrosis and early loosening, are the special threads on the pins with a narrow shoulder and a long flange, in contrast to the standard broad-shouldered machine-thread screws. For experiment regarding contiguous tissue necrosis and erosion of the metal, four pins were buried in living bone for a total of twelve weeks. All were quite loose at the expiration of nine weeks but the pins showed little more than superficial oxidation when removed.

Some further interesting information as to the fixation properties of the special thread was furnished by experimentation upon fresh bone secured at amputation. The results were, of course, dependent upon the thickness of the cortex, but in the case of the tibia a single screw resisted a pull of 776 pounds, and in the fibula the pin endured 366 pounds before the bone collapsed. The above results were based upon a total cortical burial of six and four and one-half millimeters respectively. Comparison between the Lane screw and the special screw revealed a difference in resistance in favor of the latter of forty-three pounds per millimeter of bone invaded.

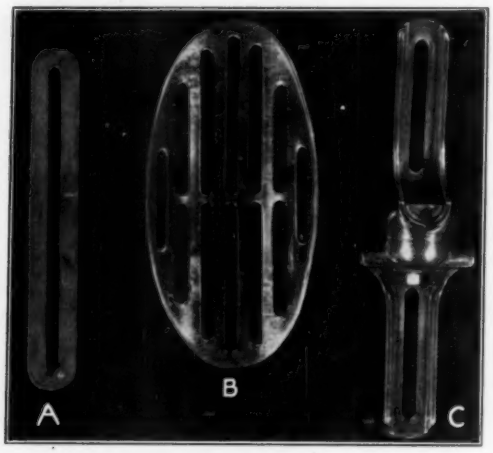

FIG. 1

A. Lambotte clamp.
B. Multiple slots in curved plate.
C. Author's adjustable clamp.

It was early evident that the Lambotte or simple slotted plate (Fig. 1-*A*) possessed another major mechanical fault. Insertion of the four pins exactly parallel is well nigh impossible and, as this is necessary for reduction when the Lambotte or similar plates are employed, therein probably lies the real explanation of their unpopularity. An attempt was made to capitalize this difficulty by encouraging the stag-

gering of pins, fixing them in the type of plate illustrated in Figure 1-*B*, thus securing even firmer fixation. Even if satisfactory wound closure were possible with the pins emerging irregularly about the periphery, adjustment of the fracture was a matter so intricate that this multiple slotted plate was promptly abandoned as thoroughly impractical.

The present plate illustrated in Figure 1-*C* was eventually evolved as the solution and has proved eminently satisfactory. The material is duralumin, which has the lightness of aluminum and the tensile strength of carbon steel. The universal joint dividing the two halves is controlled by a steel center bolt which, when loosened, permits of a wide adjustment in any direction. The unusual construction allows, in addition to any angulation, both a horizontal and perpendicular deflection of about one inch. This has been found absolutely essential to perfect alignment of the bone ends and is, furthermore, valuable in saving time and giving the operator a perfect manual control during reduction. The fixation plates are made in two sizes.

TECHNIQUE OF APPLICATION

The early hope was held that a type of clamp could be developed which might be applied to some fractures without the necessity for other than puncture wounds in the skin. It is entirely possible that this may be true of fractures of the superficial bones, although it has not been tried. The method of application is extremely simple. After a thirty-six hour skin preparation, a straight incision is made over the site of fracture down to the periosteum. Keeping an inch or more away from the line of fracture, four parallel holes, one-thirty-second of an inch smaller than the pins, are drilled as nearly parallel as possible, transfixing the shaft, two holes above and two below the lesion. No effort is made to avoid penetration of the cortex; on the contrary the whole diameter of the shaft is pierced. The contention of the Lane plate advocates that the short screws do not pierce the cortex is ridiculous. It is of course impossible to gage the cortical depth in advance and arrest the drill or the screws short of penetration. Freeman believes that drill holes through the cortex are an actual advantage, in that they promote drainage. He quotes the experimental work of his associates, Fowler and Hilkowitz, who established the presence of protective granulations within three days after the burial of screws in living bone. With the aid of a key, four bone pins are firmly screwed into the drill holes and four nuts screwed well down the threaded portions of the shafts of the pins. The four pins are next passed through the slots in the special plate, four more nuts screwed loosely in place, and reduction accomplished by manipulation and traction. In fractures of the larger bones, it is preferable to use the heavy plate and pins.

Where serious deformity is present with interlocking fragments, reduction is best accomplished before the insertion of the pins. Also in ancient lesions it is best to first remove the excessive callus and accomplish reduc-

tion. The nuts are now tightened with a pair of wrenches and usually it will be found that the reduction has been somewhat distorted, due to the impossibility of inserting the pins exactly parallel and perpendicular. It is unwise to waste time adjusting the series of nuts bolting the four pins to the clamp. The center bolt of the plate is loosened and perfect reduction is

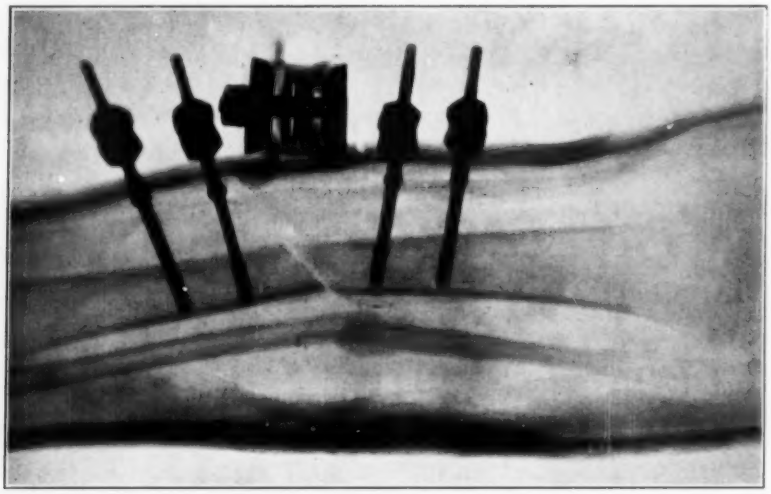

FIG. 2-A

Postoperative x-ray on ancient fracture with deformity. Exaggerated bowing.

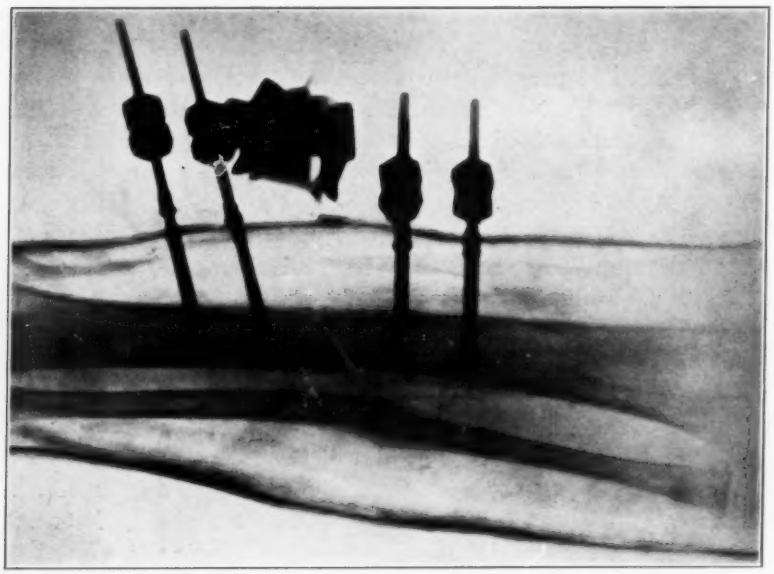

FIG. 2-B

Bowing corrected without operation or anaesthesia by loosening and readjustment of the center bolt.

immediately possible. The bolt is then tightened and, after the arrest of bleeding, the wound is closed. Interrupted sutures are suggested for the skin, placed snugly about the pins. A moist alcohol dressing is applied and a light splint, preferably of molded plaster, bandaged in place. The clamp is allowed to protrude uncovered from the wound, the dressings being placed underneath the clamp and around the pins. The dressings may be changed as often as necessary but *accumulations of dried serum must be removed from the pins frequently* and the wound moistened daily with alcohol. The stitches are removed in the ordinary manner on the seventh to the tenth day. The pins should be removed whenever sufficient union

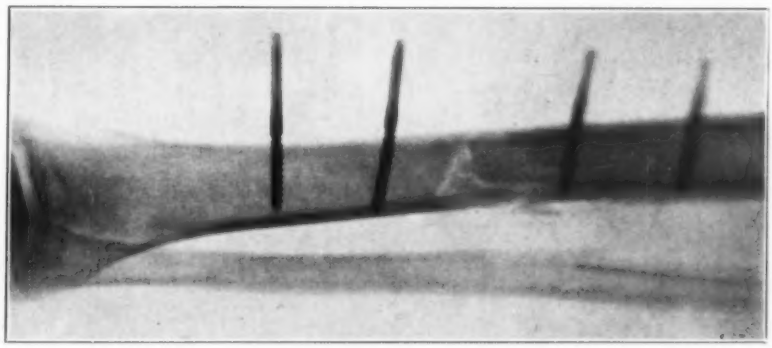

FIG. 3

Comminuted fracture; immediate operation. Union in four weeks.

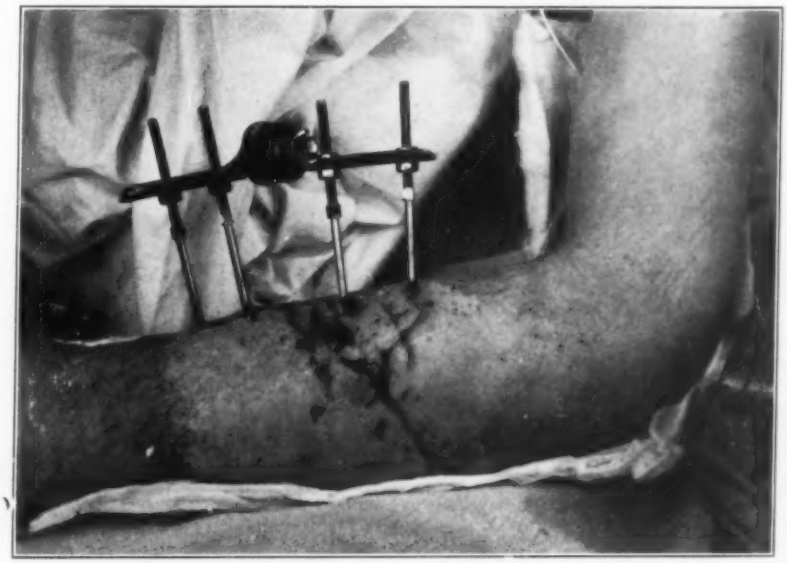

FIG. 4

Author's clamp ten days after application to a severe compound comminuted fracture of both bones of the forearm. Perfect fixation, primary healing.

RESULTS OF TWENTY CONSECUTIVE CASES

Age	Lesion	Indication	Duration of previous treatment	Burial	Suppuration	Loosening	Result	Remarks
10	Compound comminuted fracture, middle third, right tibia and fibula.	Overriding.	20 days	15 days	None	None	Excellent	Spiral fracture. Sufficient traction impossible.
16	Compound comminuted fracture, middle third, left radius and ulna.	Malposition.	3 days	30 days	Yes	None	Good	Severe infection involving both bones. Sequestra removed from radius—healing and union in good position. Lane technique broken at operation.
38	Comminuted fracture lower third right humerus, with involvement of musculospiral nerve.	Malposition. Paralysis.	49 days	27 days	None	None	Excellent	Accidental refracture, irreducible by manipulation.
41	Lower third, right tibia and fibula.	Non-union. Deformity.	77 days	28 days	None	None	Excellent	Large clamp used to straddle site of bone graft and relieve torsion.
54	Compound comminuted fracture, left tibia and fibula.	Overriding. Malposition.	14 days	38 days	None	Yes	Excellent	Upper screw loosened but fixation firm.
46	Middle third, right tibia and fibula.	Overriding. Delirium.	3 days	36 days	None	None	Excellent	Unmanageable delirium. Skull fracture. Potts' fracture left leg. Repeatedly kicked clamp with cast on opposite leg. Broke one screw off in situ. Subsequently removed. Sinus persisted for six weeks.
32	Spiral fracture, lower third, right tibia and fibula.	Malposition.	7 days	23 days	None	None	Excellent	Refused Stienmann pin and requested operation.
52	Spiral fracture, lower third, right tibia and fibula.	Irreducible overriding. Delirium.	3 days	29 days	Yes	Yes	Poor	Lower pin inserted in cancellous bone near ankle. Early loosening—poor fixation. Suppuration. Recurrence of deformity.
58	Ancient fracture, lower third, tibia and fibula.	Crossed union. Severe angulation. Complete disability.	14 months	18 days	None	None	Excellent	Osteotomies of tibia and fibula. Clamp applied to maintain the obstinate deformity in correction.
44	Spiral fracture, upper third, left tibia and fibula.	Unreduced. Overriding. Angulation.	18 days	28 days	None	Yes	Excellent	Upper pin in cancellous bone.—Early loosening.

Age	Lesion	Indication	Duration of previous treatment	Burial	Suppuration	Loosening	Result	Remarks
37	Compound comminuted fracture, lower third, right tibia and fibula.	Deformity. Overriding. Marginal necrosis.	17 days	51 days	Yes	Some	Good	Excellent fixation for 51 days despite severe sloughing at time of application. Some loosening of lower pins at end of fourth week.
24	Middle third, right radius and ulna.	Angulation. Crossed union. Flexion deformity.	7 months	17 days	None	None	Excellent	Firm fixation despite obstinate deformity.
23	Lower third, left radius and ulna.	Malposition. Overriding.	21 days	29 days	None	None	Excellent	Repeated attempts at manipulative reduction unsuccessful.
35	Compound comminuted fracture, left radius and ulna.	Extensive loss of soft parts. Dorsum of forearm.	1 day	35 days	None	None	Excellent	Very severe injury. Amputation considered. See illustration.
32	Ancient fracture, right radius. Crossed union.	Loss of rotation in forearm.	193 days	23 days	None	None	Poor	Angulation of radius corrected. Anatomical result perfect. Subsequent excessive callus reinduced synostosis.
28	Ancient fracture, middle third, right radius.	Non-union.	211 days	32 days	None	None	Excellent	Clamp used to straddle site of inlay bone graft and relieve torsion.
26	Ancient fracture, upper third of ulna. Fracture of head of radius.	Non-union. Deformity. Loss of rotation.	173 days	27 days	None	None	Fair	Clamp used to straddle site of osteoperiosteal bone graft and relieve torsion. Resulting non-union from this and two other bone grafts by different operators.
22	Comminuted fracture, lower third, tibia and fibula.	Overriding.	16 days	30 days	None	None	Excellent	None.
12	Spiral fracture, middle third of femur.	Overriding. Angulation.	20 days	27 days	None	None	Excellent	Excessive callus at operation. Overriding easily overcome on Hawley table.
28	Fracture, middle third of radius and ulna.	Overriding. Deformity.	33 days	32 days	None	None	Excellent	Previously applied Lane plate loosened. Deformity recurred. Plate removed. Clamp applied.

has begun to assure permanence of the reduction. Normally the removal is possible between the third and fifth weeks. Loosening of the center bolt permits of manual examination of the beginning union, and the removal of the plaster splint allows early massage. The stabilization obtained is remarkably firm and the usual postoperative caution relative to mobility of proximal joints is not necessary. If a recurrence of deformity should take place or subsequent x-rays indicate that the reduction is not perfect, readjustment is easily made without recourse to a second operation (Figs. 2-*A* and 2-*B*).

SUMMARY

We would caution against the insertion of pins close to large joints in the expanded and cancellous bone, as early loosening or unsatisfactory fixation has often followed. Loosening has likewise resulted from the accumulation of dried serum about the pins and therefore a daily cleaning with benzin or ether is imperative.

The virtues of the clamp have been chiefly its excellent fixation properties, its ease of application, and its extreme comfort. Removal of the pins has usually been less painful than the removal of the skin sutures. In no case has union been delayed and the early motion of the contiguous joints which is possible has induced prompt return of function. The method is not contra-indicated in compound and infected lesions, as the stabilization has proved beneficial, and the area of soft part straddled is left free for wound treatment.

The external clamp possesses obvious advantages over any buried material trespassing the area of repair and requiring operative removal.

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DYSCHONDROPLASIA*

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Dyschondroplasia has been definitely removed from the category of tumors and is now recognized as a disturbance of bone growth which begins in childhood. It is characterized by the expansion of the ends of the long bones and by the appearance of multiple cartilaginous growths at the ends of those bones.

This disorder is not an uncommon one, for in reviewing the literature on this subject there are to be found about 400 articles dealing with over 700 cases. These include cases drawn from the literature of all countries; the following are the percentages from the various countries:—Germany, sixty per cent.; France, twenty-seven per cent.; England, eight per cent., other countries five per cent. Thus this disorder appears to be world-wide in its distribution, Germany having the greatest number of recorded cases.

Cases showing the typical characteristics of this disorder and the influence of heredity have recently been described from India and other parts of the Far East. Taking the recorded cases as a whole, males appear to be affected more than females, approximately in the proportion of three to one; but in the limited number of cases reported from India, the females slightly predominate.

The great majority of cases are associated with stunted growth; the stunting is confined to the limbs only, the trunk maintaining its normal length, but a few cases of gigantism with multiple exostoses have been described in the French literature.

Heredity plays a very important part in this disorder; this was clearly brought out by Cossage and Carling in an exhaustive paper on this subject read before the Royal Society of Medicine in 1910. These writers demonstrated that it frequently extends throughout several generations, and that it is rare to find isolated cases; in these so called isolated cases one generally finds on investigation quite an extensive family tree, but occasionally a generation may be skipped. The line of descent appears to be distinctly more paternal than maternal; and there is no case on record in which transmission has taken place through an unaffected male, although the malady may be passed on by an unaffected female. Many family trees have been worked out more or less completely.

The appended tree is that of a Chinese aged fifty-two, the details of whose history are recorded later in this paper. This family tree is for the male members of the family only. Little or no records were

*Read before the Surgical Section of the Far Eastern Association of Tropical Medicine, at Bangkok, Siam, December 8, 1930.

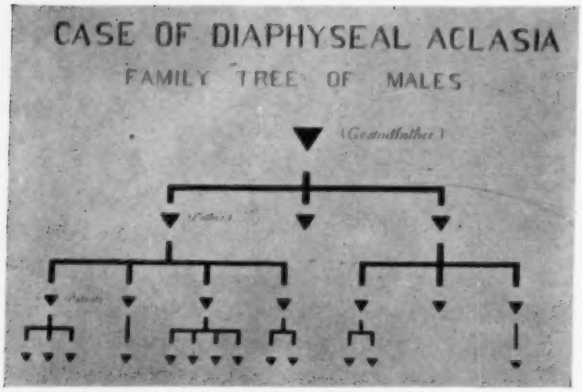

FIG. 1

Family tree of four generations showing the affected males only.

obtainable regarding the female side of the family as the daughters of Chinese do not seem to receive the same consideration as do the sons. The father in this case has had children by two Siamese wives and the children by both wives are affected, indicating very clearly that the transmission is definitely paternal.

CASE REPORT

The following case illustrates well the family tree and malignant changes developing in an exostosis. The patient is a Chinese aged fifty-six years, an opium addict, who came to the Siriraj Hospital, Bangkok, on July 12, 1929, complaining of a swelling of the left knee and left foot which prevented him from walking.

On investigation he gave a family history of the same malady affecting his grandfather, father, brothers, children, and nephews. The family tree is shown on the accompanying chart.

His present illness dates back to childhood when he noticed a hard mass on each thigh just above the knee, more marked on the inner side than the outer. These masses slowly increased in size until the age of twenty-one, then they remained stationary, not causing any trouble until the age of forty. Fifteen years ago, the left one slowly began to increase in size; this slow enlargement continued until six months ago, when the rate of growth became much more rapid; so that now he is unable to walk from sheer size of the tumor. Although the tumor has increased in size, he has felt fairly well, but he says that lately he has lost weight.

FIG. 2

Patient, showing size of tumor.

Examination:—The accompanying photograph gives the best idea of the size of the tumor. In the right popliteal space there is a large pointed exostosis and also one on the right scapula which is causing considerable depression on the ribs on that side.

Laboratory examinations:—

Blood:—Red blood cells—3,090,000
Hemoglobin—50 per cent.
White blood cells—7,300
Color index—.83

Wassermann reaction—negative

Kahn test—2+

Urine:—Trace of albumen with hyaline and granular casts.

X-ray Examination:—Film of the left thigh and knee shows an enormous tumor formation involving the lower two-thirds of the femur. On the posterior surface of the femur there is a remnant of the exostosis from which the tumor arose; small irregular islands of ossification are scattered throughout the mass. Film of the right femur shows a large pointed exostosis. The chest shows no evidence of metastases.

Diagnosis:—Dyschondroplasia with sarcomatous degeneration, arising from an exostosis on the femur.

Treatment:—Amputation in the region of the left hip joint was advised; to this the patient readily consented. The operation was performed on July 21, 1929, under spinal anaesthesia; hemorrhage was controlled by a tourniquet applied above two Wyeth's pins. An external racket incision was made and the femur was divided just below the lesser trochanter. The patient made an uninterrupted recovery.

Pathological examinations:—The specimen is the complete leg with a huge lobulated tumor involving the lower two-thirds of the thigh and weighing 19.75 kilograms. On section the growth proves to be composed of grayish translucent cartilaginous tissue which involves the epiphysis of the lower end of the femur and extends upwards in the marrow to just below the section of the bone at the line of operation. It has perforated the compact bone four centimeters above the epiphysis and extends outwards in all directions. The tumor tissue itself is completely enclosed in a thick layer of grayish firm tissue and contains scattered irregular spaces filled with blood-stained fluid.

Microscopic section of the growth shows it to be made up of irregular masses of closely packed cartilaginous cells intersected by bands of fibrous tissue in which are blood vessels. The tumor cells have many mitotic figures and in general have undergone mucinous degeneration; in a few places they show calcification.

Pathological diagnosis:—Chondrosarcoma.

CONCLUSIONS

1. There is described a case of dyschondroplasia occurring in a Chinese, showing a family tree well marked with the disease and malignant degeneration occurring in one of the exostoses.

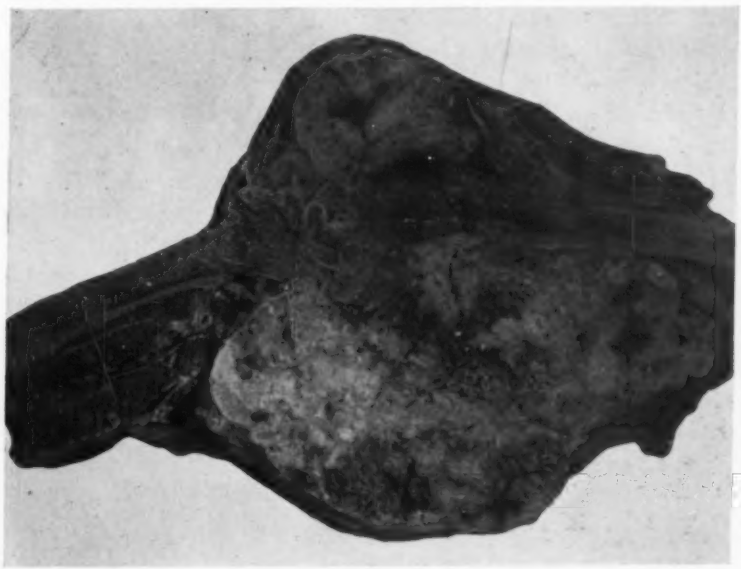

FIG. 3
Section of amputated limb.

2. In any case of dyschondroplasia in which an increase in the size of an exostosis takes place after growth of the skeleton is complete, it is strongly suggestive of malignant degeneration at that point.

3. Dyschondroplasia has a world-wide distribution and in the East it shows the identical characteristics that it does in the West.

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THE SURGICAL CURE OF HALLUX VALGUS

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While it may be safely assumed that in some instances hallux valgus develops secondarily and inevitably from a congenital primus metatarsus varus, we believe that in the majority of cases the deformity at the big toe joint is the important one. In this larger group there are occasional instances where, following severe involvement in infective arthritis, the valgus deformity may be accompanied by extensive damage and pathological changes in the articular tissues both soft and hard. But it has been our experience that such constitute a very small percentage of cases of bunion, the great majority showing good articular surfaces.

The operative procedures for relief, which, in this country at least, have met with the widest favor—possibly because on the whole they have given the most satisfactory results—are the operations of Hueter, of Mayo, and of Keller, with minor technical variations which are probably almost as numerous as the number of individual operators. Comment will be made on the results secured by these procedures later. We wish to emphasize at this point that in spite of the fact above suggested,—*i.e.*, that bunion represents a member deformed in contradistinction to a joint diseased or destroyed—these operative procedures embody so radical and extensive an attack on the integrity of the joint that they would seem to represent technically an arthroplasty, or reconstruction by a nearthrosis. With such procedures a slow and rather painful convalescence and much careful protection of the new joint until entirely stabilized, seem inevitably necessary, and complete restoration of full functional activity hardly to be expected.

For some time it had seemed to us that there was a serious inconsistency in the rationale of such types of operative treatment for the majority of cases of hallux valgus. Except for painful bursae, we had been left with the impression that these joints were in a very satisfactory state of preservation, in spite of the functional handicap of their deformity. In old cases, to be sure, there was some generalized lipping around the joint, some fibrillation and thinning of joint cartilage, beside the major exostosis or bunion. But these changes, while corresponding to the second great type of arthritis, are readily explained on a basis of traumatic arthritis or joint wear, rather than as involving an infection or inflammation in the literal sense. The articular cartilage, the underlying cortical bone, and the synovial membrane, all seemed probably more serviceable for the purposes required than the best reproduction nature could provide in a nearthrosis.

With this premise it appeared to us as irrational to do an arthroplasty or an excision of this joint as it would be to do the same for the relief of genu valgum. For a more complete analogy,—the presence of an hypertrophied

adductor tubercle or of an osteoma at the inner side of a knock-knee would not to anyone suggest the necessity of an excision of the knee. The logical attack would be the excision of the osteoma accompanied by the Macewen osteotomy for correction of the deformity. If the osteoma involved the attachments of the mesial collateral ligament of the knee, this ligament would naturally need appropriate attention in its reattachment. Thinking of hallux valgus in the light of this analogy, the distinction seemed to be one of quantity or size rather than of quality or pathologic principle, but not to a degree impracticable from the angle of operative technique.

Accordingly in 1922* an operative technique was evolved on the basic principle of a skeletal or structural readjustment and correction of deformity, with maximum preservation of the functionally efficient tissues of the joint. This technique became at once so gratifying in its results that, save for the few definite rheumatoid cases (requiring joint excision or modified arthroplasty), it has regularly been employed. It has also developed that the first assistants in the clinic, after a little observation, have been able to obtain practically the same results, so the operation cannot be regarded as one of great technical difficulty. We were tempted to imagine some originality in this technique until, from a reference in Steindler's recent book, it was observed that the principle was much the same as that advocated and practiced by Hohmann and described by him in 1923. But though based on similar principles, the technique to be described differs in a number of details which, it is felt, affect the end result. It also appears from mention made in an orthopaedic text published by Taylor about twenty years ago that a similar basis for operative attack had been advocated and practiced by Reverdin.

In the writer's operation the following are the essential points: (1) preliminary excision of exostosis; (2) cuneiform or trapezoid resection just proximal to the articular surface; (3) realignment of joint without sacrifice of any part of it; (4) reconstruction of mesial collateral ligament.

According to Taylor, Reverdin's operation, as illustrated by a cut taken from Berger and Banzet, included the essential steps of the writer's technique save for the plastic nature of the osteotomy and for the attention to the reconstruction of the mesial collateral ligament.

Hohmann's technique is considerably different in that a trapezoid resection of the shaft is done *proximal* to the exostosis, apparently to greatly shorten the big toe as well as correct the valgus. The joint is not opened and the bursa and exostosis are not interfered with. Apparently the prominence of the exostosis becomes less as the head of the first metatarsal is pulled back of that of the second and settles laterally against the neck of the latter bone. Hohmann, in his own report, includes in the technique a plastic shortening of the tendon of the adductor hallucis. No particular provision is made for control of bone apposition at the time of operation.

*This paper was prepared and presented locally in January 1928. Motion picture of operative technique was presented at Clinical Congress of Surgeons, Detroit, October 1927.

In his report the convalescent period and the external fixation was considerably extended, compared with that found necessary by the writer. Plaster-of-Paris fixation was maintained for about three weeks followed by a starch bandage for a similar period and then foot plates. This convalescence is probably necessary because of the narrower and less secure bone contact prevailing in his technique. It might also appear that the very considerable shift of position of the first metatarsal head might compromise the transverse metatarsal ligament and arch.

Recently Mr. H. McCrae Aitkin of London, when the writer's method was described to him, told the writer that for several years he had been using nearly the same technique, save for the skin incision and the method of internal fixation. He had not described it in the literature himself although he could not recall any other description of it, but felt thoroughly convinced from his results that it was preferable to any other method.

The writer's operation differs from that of either Reverdin or Hohmann in that the wedge resection to correct the valgus is done not in the lower end of the shaft, where the bone is narrow, but in the head where wider surfaces of apposition will prevail and where osteogenesis is more active, so that it is not an extra-articular operation. It differs again in that, whether the resection is a pure wedge (Reverdin) or more of a trapezoid (Hohmann), it does not quite traverse the entire width of the bone, but leaves the articular or capital fragment prolonged by a thin segment from the lateral (interdigital) side of neck and shaft, and at this side there is undisturbed continuity of capsule and periosteum. Furthermore, no mention is made in the technique of these two surgeons of any means of maintaining position and apposition of the bone fragments, such as is obtained in the writer's technique by the fixation suture. Finally, the removal of the painful exostosis secured by our method is not attempted in the Hohmann operation.

THE OPERATION IN DETAIL

Usually under local or regional anaesthesia, the joint is exposed by a curved dorsomedial incision extended along the side of the metatarsal, and the superficial layers are considerably dissected back only in this proximal part. Incision in the capsule begins at the edge of the phalanx and continues around the exostosis on the dorsum of the joint, and thence through the periosteum of the neck of the bone where it curves mesially nearly to plantar aspect and continues back nearly to the joint line. The outlined flap of capsule, bursa, and periosteum serves later for the reconstruction of the mesial collateral ligament. The bursa itself is freed from the exostosis and turned down in the flap, but is not otherwise dissected or excised as it will return to its normal size after removal of the irritating exostosis; and remains to provide the normal cushion on this side.

Reflection of the flap opens the joint and exposes the exostosis, which is liberally excised flush with the neck of the bone (See Figure 1), and a thin shaving in addition is cleared from the side of the metatarsal neck, providing

FIG. 1
Line of first bone section.

FIG. 2
Exostosis h s been removed. Note lines of transverse bone section, removing cuneiform or trapezoid segment, depending on degree of deformity. The lateral cortex is not included in the segment removed, but is fractured obliquely. Drill holes for fixation sutures made before osteotomy.

a raw bone surface for reimplantation of the capsular ligament. A small drill hole is then made from dorsal to plantar aspects, in the angle between the articular cartilage and the section by which the exostosis was removed, and a second is correspondingly placed an inch proximally through the mesial edge of the shaft; a chromic gut suture is passed through the holes and drawn aside.

With motor saw or thin osteotome a wedge-shaped resection of bone is made between these holes but not quite through the opposite cortex (See Figure 2). By inserting the osteotome after the wedge is removed, and directing it proximally, a thin segment still attached to the head can be split off from the shaft at its interosseous aspect. The capital fragment then falls in against the neck closing up the defect, and is held in this position by tightening and tying the suture which has previously been passed through the two drill holes (See Figure 3). The lately functioning surface of the head of the metatarsal is thus found to be shifted from a valgus to a slightly varus position. The size of the wedge of course controls the degree of the shift and the amount of indicated shortening of the big toe. The overlapping shelf or spicule at the interosseous aspect (seen better in the postoperative films) adds to stability and repair, as does the taut and intact capsule at this side of the joint.

With the big toe in varus position the extensor and flexor tendons

realign themselves over the axis of the joint. Holding the toe in this position, the mesial capsular flap is pulled taut proximally against the roughened surface of the shaft, being secured here by a few sutures, with sufficient tension to hold the overcorrected position. Zero chromic catgut is sufficiently strong for this purpose and 00 for the remainder of the closure. A tongue-blade splint is applied mesially and another on the plantar aspect, so padded as to hold the toe a little plantar-flexed. The whole forefoot is snugly bandaged over a pad under the transverse arch.

POSTOPERATIVE TREATMENT

With removal of stitches on the tenth or twelfth day a collodion dressing is applied and a foot mold taken. This is modelled for a plate with a strong anterior raise and with a toe post on the leather insole. On this plate walking can be allowed in the third week in a cut-out shoe or slipper, with fitting of a new straight-lasted shoe in the fourth week. Joint motion is encouraged and all splinting discontinued except for a night splint after the first two weeks.

At the beginning of this series the rate of union of the osteotomy was studied with considerable interest as it was thought that weight-bearing might not be safe for several weeks. Without exception solid bony union occurred in a remarkably short time. At the end of two weeks callus formation, which underlay the readjusted mesial collateral ligament, had filled in the marginal discrepancy between the capital fragment and the narrower neck, and a month later the line of osteotomy could be seen with difficulty. The first foot plates were designed to take the weight on neck and shaft, and patients were cautioned not to step on the forefoot without them in the first month; but as they began to report walking to bathroom,

FIG. 3

Bone excision completed and toe position corrected, closing up gap. The substance of the film has been cut away in the same degree as in the actual bony resections, and the gap proximal to the articular surface closed up into approximation as prevails when the bone suture passed through the drill holes is tied. The clear area beside the metatarsal head is the defect left in the film by cutting out the shadow of the exostosis itself.

FIG. 4
Pre-operative x-ray of typical case.

FIG. 5
Case shown in Fig. 4, with condition immediately postoperative.

FIG. 6

Typical case of bunions, pre-operative.

FIG. 7

Same case as Fig. 6, one month after operation. Patient started walking on fifteenth postoperative day. Note preservation of normal articular surface as well as elimination of enlargement of metatarsal and of the deformity.

etc., in natural manner without discomfort, the rapidity of union was confirmed and the plate made to support only the anterior arch.

It has been previously stated that the general results were most gratifying. This was in comparison not only with previous experience but with observation of results of many others, including Spiers' study of end results from the Massachusetts General Hospital.

(1) The cosmetic result is absolutely perfect, the toe in no way having the suggestion of a maimed or deformed member. The anatomical basis of this is evidenced by the x-ray appearance, films taken a few months after operation once having been reported by an unsuspecting roentgenologist as negative for any variation from normal.

(2) The convalescence is shorter and more comfortable.

(3) Mobility of the joint is obtained without sacrifice of power, so that normal amount of weight and plantar pressure can be sustained by the big toe to its full length.

(4) There has been no recurrence of the deformity without shoe abuse.

(5) The painlessness and strength of the restored joint has allowed recovery of control of postural defects of both arches.

In a few cases a primus metatarsus varus, when of considerable degree, has been corrected by wedge excision of part of the metatarsocuneiform joint, assuring permanent correction by ankylosis of this relatively un-

FIG. 8

Pupil nurse incapacitated by bunions after a few months' training, with apparently congenital valgus deformity of big toe joint and last phalanx.

FIG. 9

Late result of case in Fig. 8. Resumed training and finished with no symptoms at any time. Recent check-up three years after operation. Patient has been on regular duty, and has had no difficulty with feet.

necessary joint. This has not been found to add any time to convalescence. Operative procedures previously observed have failed in their results to secure so many of the advantages enumerated above. The technique confining attack to the exostosis itself seems to favor recurrence. In fact, in a few bilateral cases of our own with a very minor deformity on one side, the latter has been treated in such fashion or after the manner of Silver, but in the end the patient has considered the method used on the other side to have been the better. The more mutilating procedures apparently have fewer recurrences, but leave a weakened toe after a painful convalescence.

END RESULTS

Up to 1928 this operation had been performed on fifty-five patients, 106 feet being operated upon. Recall letters were then sent out to all patients of a year's standing. Information as to results was obtained from twenty patients, all with bilateral operations, and sixteen of these twenty reported in person for detailed examination. All reported complete satisfaction with the final condition of the toes operated upon. One patient was classified as partially relieved, as she still had some lameness after a long walk. Another was placed in the same classification, as her main complaint before operation

had been metatarsalgia and she still required a support for relief of this. Of the thirty-two feet reexamined, deformity of the big toe joint was absent in twenty-seven with first-degree valgus in five. Mobility of the joint was good in twenty-five, fair in seven, poor in none, absent in none. To be "good" some plantar-flexion and normal dorsiflexion were required. Full power against resistance without pain was present in all. Statics of the feet as a whole was found improved in twenty-five, unchanged in seven. Since this end-result study was made, it has also been possible to reexamine several cases between five and seven years after operation, each showing correction still maintained and reporting entire satisfaction.

CONCLUSION

There has been devised a surgical treatment for hallux valgus, based on a conception rational in mechanism and pathology, which is technically facile and has been justified by its end results. It is not to be recommended to the surgeon who allows half an hour for the cure of bunions.

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ELASTIC TRACTION ASSISTING CORRECTION OF CLUB FEET

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The use of elastic traction in the correction of club-foot deformities is neither new nor sensational. Various forms of such traction have been used by many workers with varying degrees of success. This particular type of apparatus is presented because it has materially reduced the time required for the correction of club feet, and offers a gradual, constant, effective pressure with a minimum of trauma and danger.

The apparatus, as can be seen in the photograph, consists of a plaster cast applied in two parts,—one piece from the mid-thigh to the ankle and a separate piece on the foot. Incorporated into the cast are two strips of aluminum,—one about two inches below the knee, and the other across the plantar surface of the foot in the most advantageous position for applying the traction. The position of the aluminum strip across the sole of the foot varies according to the deformity. The metal strips are about six inches long, about three-quarters of an inch wide, and are one-eighth of an inch thick. They can easily be cut with shears from a flat piece of metal. The ends of the strips are curled into hooks with pliers to fit the diameter of an ordinary lead pencil. The upper strip, placed below the knee, is bent by hand to approximate the shape of the calf of the leg, or the anterior surface of the leg. Only the curled ends of the metal strips are left protruding from the casts.

In applying the casts it is advisable to use a strip of heavy felt across the dorsum of the foot and near the ankle, so that when pressure is brought to bear on these parts by the elastic traction, the rough edges of the cast will not cause sores. The upper part of the cast is applied with the knee bent, to prevent twisting, and care must be exercised to shape the plaster of the lower part snugly around the heel to prevent the foot piece from slipping forward. Only one layer of sheet wadding is used next to the skin on the lower piece.

The rubber bands are hooked on immediately after the casts are applied merely to hold the parts in place, no attempt being made to exert corrective traction until the casts are dry. The patient must be confined to bed and remain recumbent. The leg is then suspended from the cross bars of an ordinary cradle, such as is commonly used to prevent bed coverings from coming in contact with an extremity. Nothing should be permitted to come in contact with the cast or rubber bands, nor should the cast rest on the bed for that impedes the traction. When the cast is thoroughly dry, corrective traction may be started.

There are four possible directions in which the traction can be applied, and by varying the strength and the combination of rubber bands used, the

proper force can be exerted. A fifth force can be brought into action,—namely, that of gravity; for by suspending the leg, so that the medial side is upward, the foot tends to drop and a possible inversion deformity may be overcome. While this apparatus has been used for several types of club

FIG. 1

FIG. 2

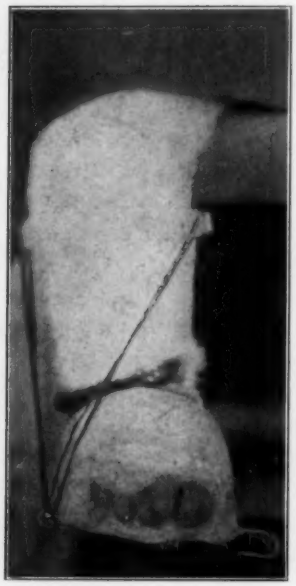

FIG. 3

FIG. 4

Series showing correction of deformities of an eighteen-months-old child, with elastic traction following achillotenotomies and plantar fasciotomies.

feet, the greater experience has been with the common equinovarus deformities. With this type the leg is suspended with the medial surface upward so that the foot may come into eversion more readily. Rubber bands are applied, running from the inner and outer sides of the foot piece

FIG. 5

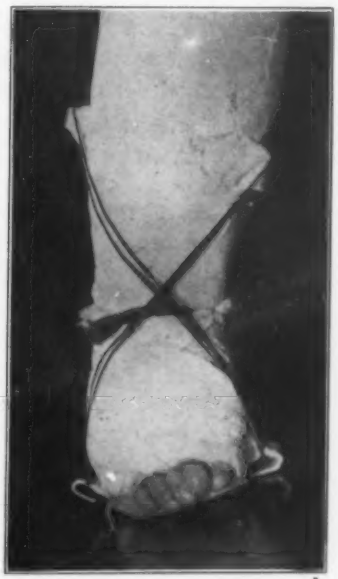

FIG. 6

FIG. 7

FIG. 8

Series showing correction of deformities of a thirteen-year-old child, with elastic traction following astragalectomies.

to the outer side of the metal piece near the knee. If the varus deformity is more resistant than the equinus deformity, stronger bands are used on the outer side with smaller bands across the leg. When the elastics are applied, it can easily be seen which combination will be the most effective in the individual case.

Caution should be exercised to use only weak rubber bands, and very few of these, at the start of the traction. It is surprising to find the amount of tension which such bands can cause, and the circulation in the toes should be watched carefully. Other bands can be added as may be found necessary. Too hasty correction is apt to cause undue discomfort and circulatory embarrassment.

The principal advantages which have been found with this apparatus are the speed of correction and the extent of correction. It has usually been found inadvisable to attempt to obtain full correction of moderately severe club feet at one manipulation or following any operative procedure. We have always been content to secure partial correction at the initial effort and to rely upon weekly changes of casts with gradual improvement in position to bring about the desired result. From six to ten weeks was usually required to bring the foot into a position of overcorrection in which it was maintained by casts for varying lengths of time, depending on the case. By the use of the elastic traction the same result of bringing the foot into position of overcorrection has been obtained in from two to ten days. As yet it has never been found necessary to leave the elastic traction on longer than ten days, and that long only in two cases. As soon as the desired position is brought about, a solid cast is applied. The gradual stretching of the structures seems to allow the circulation to accustom itself to the changing position, and the minimum of trauma prevents undue swelling. The shortening of the period of obtaining safe correction from about six weeks to one week, and the extent of the correction, permits a considerable decrease in the length of time the patient has to be in casts, and cuts down materially on the length of hospitalization.

This elastic traction has not been used in place of manipulations or such other operative procedures as may be necessary, but as an adjunct in the treatment. To date this traction has been used successfully in eleven cases, in two of which there were talipes equinovarus deformities as part of a generalized condition of arthrogryposis congenita multiplex.

SUMMARY

1. Elastic traction may be used to shorten materially the length of time necessary for the correction of club feet.

2. This traction provides a constant, effective pressure which brings about change in position slowly, and permits the circulation to readjust itself to the changing position.

3. By means of elastic bands a variety of different units of force can be applied, making this form of traction adaptable to practically all types of club feet.

A NEW OPERATION FOR ARTHRODESIS OF THE SHOULDER*

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DESCRIPTION OF THE OPERATION

A circular, or horse-shoe, incision is made about the acromion one-half inch below its border. At the point of the shoulder over the greater tuberosity of the humerus a vertical incision is carried downward from the first incision for a distance of about two inches. This divides the skin over the arm into two small flaps, one anterior, the other posterior. All three skin flaps are then dissected away freely from the underlying fascia.

A deep incision is then made about the tip and the lateral edges of the acromion, separating the deltoid from its attachment to the acromion. No fibers of the deltoid are to be seen as it is atrophied. Only the rather dense and strong deltoid fascia remains. The upper portion of this is cut away for about an inch, revealing the capsule of the shoulder joint lying underneath.

The capsule is opened and is freely excised over the upper part of the joint from its attachment to the edge of the glenoid fossa to within an inch of its attachment to the humerus. This excision may be facilitated by a

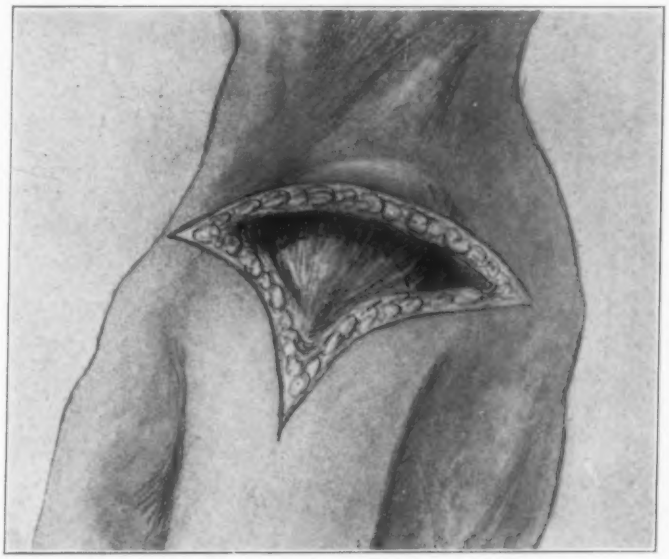

FIG. 1

Showing skin incisions around the acromion and downward from its tip.

*Presented at the meeting of the American Medical Association, Detroit, Michigan June 1930.

longitudinal incision through it corresponding to the longitudinal incision in the skin. The extracapsular tissue beneath the acromion is excised with the capsule. Moderate bleeding is encountered as one excises the tissues toward the anterior and posterior parts of the root of the acromion. This is easily controlled with a forceps or by packing for a brief time.

The long head of the biceps has been identified and spared in making this excision. If by accident it is cut from its origin at the superior edge of the glenoid, no particular damage is done as it may be thrust into the shoulder joint to become embedded in the bone when the joint becomes ankylosed.

A half inch to an inch of the capsule is left attached to the humerus above the greater and lesser tuberosities for a purpose to be made clear later.

The inferior surface of the acromion is then denuded of periosteum with a sharp thin osteotome. With the same instrument the periosteum is elevated from the superior surface of the acromion and left attached at its

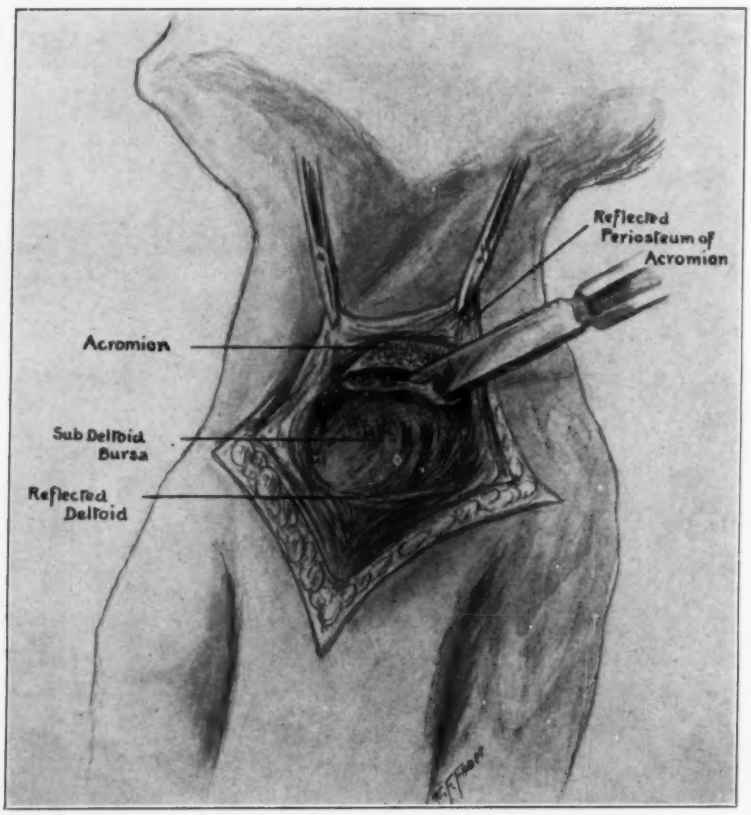

FIG. 2

Showing detachment of the deltoid from the acromion, the reflection of the periosteum from the superior surface of the acromion, and the denudation of the inferior surface of the acromion.

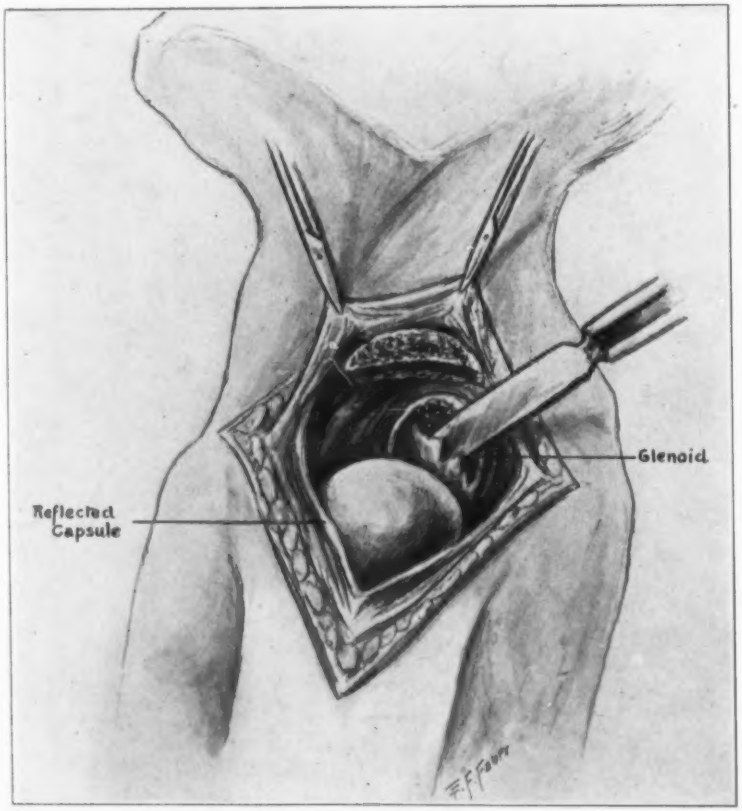

FIG. 3

Showing the excision of the upper part of the capsule, the exposure of the head of the humerus, and the removal of the cartilage from the glenoid.

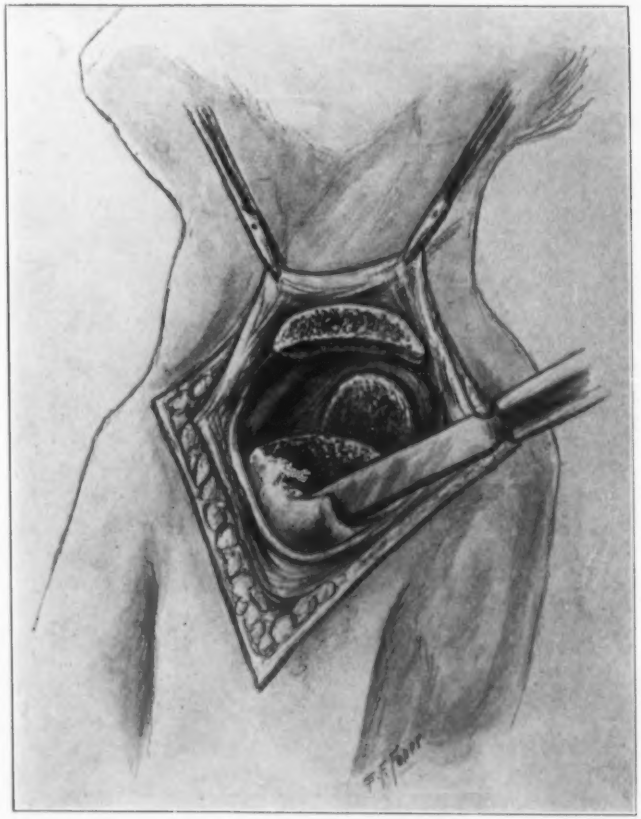

FIG. 4

Showing removal of cartilage and a portion of bone from the head of the humerus.

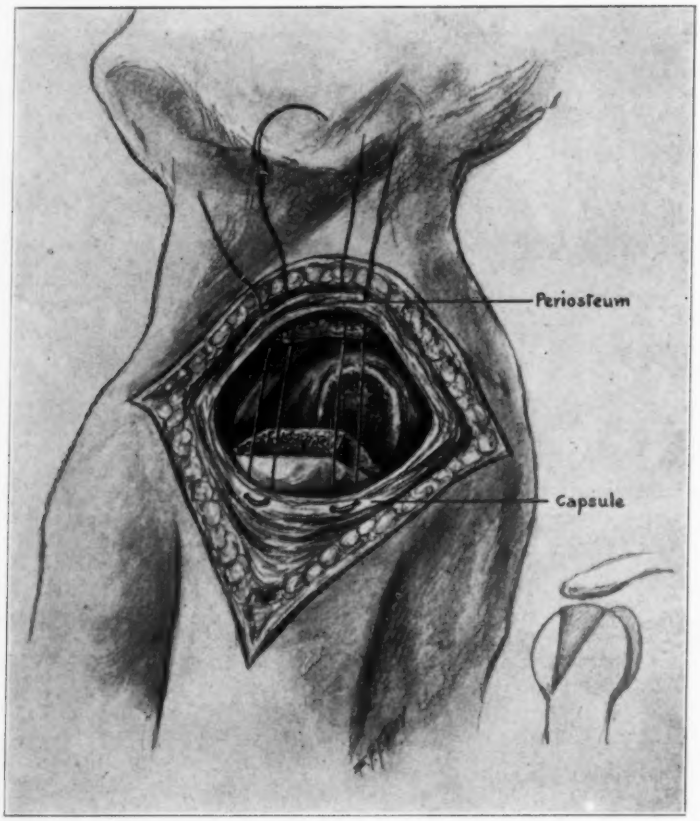

FIG. 5

The small sketch shows the wedge of bone removed from the head of the humerus, and indicates how the acromion fits into the cleft in the humerus on abduction of the arm.

The larger sketch shows the placing of sutures to maintain proper abduction of the humerus.

proximal aspect. The acromion is thus denuded of all soft tissues on its inferior and superior surfaces. The articular cartilage and the glenoid ligament are then removed from the glenoid process, and the cartilage with a portion of bone is removed from the head of the humerus.

With an osteotome the humerus is split longitudinally, so that a thin outer and anterior portion may be reflected slightly outward. A small wedge of bone with the base upward is removed from the remaining part of the head. A cleft is thus made in the humerus beneath the tip of the acromion. The capsule remains attached to the outer and anterior portion. When the arm is abducted the acromion fits into this cleft and becomes buried in it to the depth of a half inch to an inch. It is to allow the acromion to sink into this cleft that a portion of the head of the humerus has been excised with the articular cartilage.

The capsule attached to the humerus is sutured to the periosteum and its overlying fascia which have been reflected upward from the acromion. These are both strong heavy tissues and they are overlapped as they are sutured. The position of the acromion is thus maintained firmly buried in the humerus. Any attempt to adduct the arm rotates the scapula. It is the integrity of these structures which prevents rotation of the scapula after the operation has been completed and the cast has been applied, and which maintains any degree of abduction of the humerus in its relation to the scapula which the surgeon may elect.

FIG. 6

Shows how the assistant maintains proper position while sutures are being tied and the wound closed.

The degree of abduction of the humerus may be regulated in several ways during the operation. The author prefers the excision of the wedge of bone described above. The broader the base of the wedge, the less is the abduction secured. Furthermore, if the capsule and the periosteum are well overlapped and sutured firmly, greater abduction is maintained than if they are loosely sutured.

PROPER ANGLE OF ABDUCTION OF THE ARM

The author is of the opinion that the angle formed by the shaft of the humerus and the vertebral border of the scapula should not be greater than forty-five degrees. Even less abduction than this gives splendid function. Greater abduction causes difficulty in bringing the arm to the side after

ankylosis has occurred, and forces the patient to bend his body habitually to that side in order that the arm may hang straight downward.

AFTER-TREATMENT

A cast is applied with arm abducted and slightly forward so that the hand is near the mouth. It includes the entire arm and the hand, and the body down to the pelvis, so that the shoulder is firmly fixed. The portion of the cast over the upper part of the shoulder is cut away that the wound may be dressed as necessary. The cast is not removed until the end of twelve to fourteen weeks, at which time bone fusion is complete and firm. The patient then goes without support and begins to use his arm.

INDICATIONS FOR ARTHRODESIS OF THE SHOULDER

The author has employed this method of operation for shoulder paralysis due to infantile paralysis and for peripheral nerve lesions,—such as brachial birth palsy and traumatic brachial paralysis. There must be

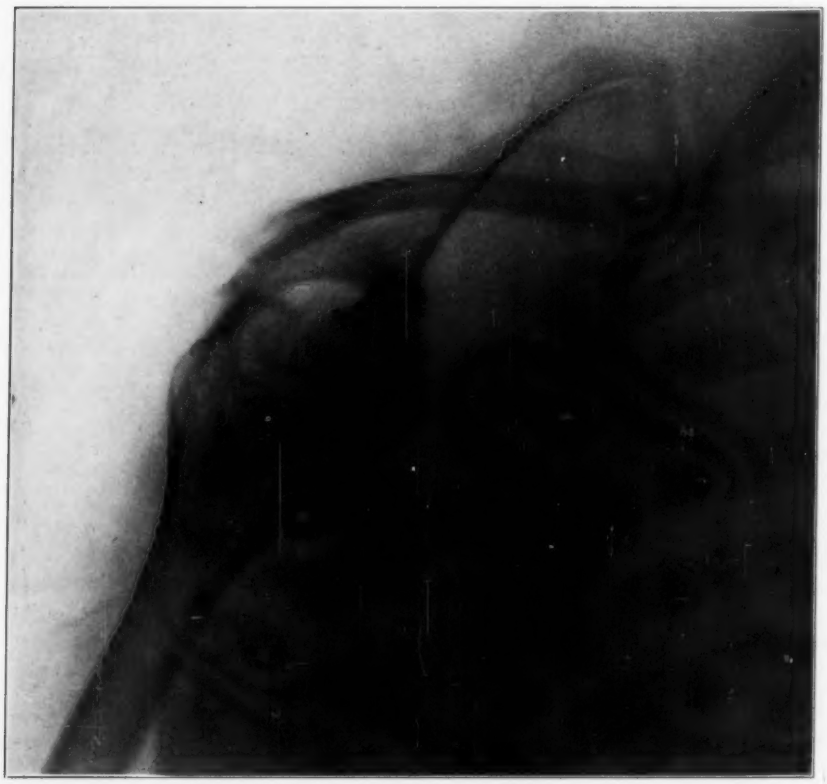

FIG. 7

A. T. Arthrodesis of the shoulder six months after operation.

FIG. 8

M. W. Arthrodesis of the shoulder one year after operation.

power in the muscles which rotate the scapula on the trunk and there must be enough power in the muscles of the extremity below the shoulder to justify the operation.

If arthrodesis of the shoulder should be done for tuberculosis, the author is of the opinion that the above method of fusing the acromion with the humerus may properly be employed with the omission of that part of the operation which attempts to secure fusion of the humerus with the glenoid.

THE AGE AT WHICH THE OPERATION MAY BE DONE

The age at which the operation may be done is approximately from ten years upward. In very young children the acromion is quite thin and cartilaginous.

THE ADVANTAGES OF ARTHRODESIS OF THE SHOULDER

The advantages of arthrodesis of the shoulder are numerous. The patient can raise his hand to his mouth and his head; he can grasp objects at considerable elevation in front of him; and, of very great advantage, he can put the weight and power of his body into pushing and pulling. This enables him, for example, to drive a team of horses.

The author has frequently seen marked improvement in the circulation of the arm and hand with a disappearance of the blueness and coldness that

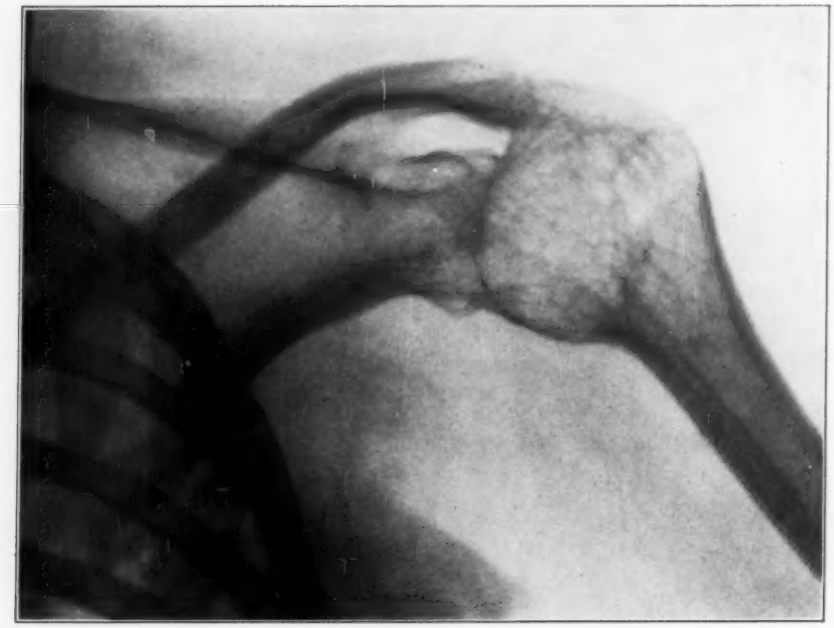

FIG. 9

S. T. Arthrodesis of the shoulder three years after operation.

FIG. 10.

R. R. Arthrodesis of the shoulder three years after operation.

formerly were present. Likewise, an improvement in power of the muscles of the extremity has been observed. These two conditions are due to the fact that the weight of the extremity no longer pulls and stretches the axillary vessels and nerves.

The functional results of arthrodesis of the shoulder are among the most satisfactory in the realm of orthopaedic surgery. Patients operated upon have included stenographers, telegraph operators, teachers, teamsters, and college students; and all have expressed the greatest satisfaction with the improvement in the usefulness of their arms.

RESULTS

The author has performed seventeen arthrodeses of the shoulder by older methods and seventeen during the past four years by the method described above. In the former group a few resulted in fibrous ankylosis. Even in these, however, the functional results well justified the operation. In the latter group bony ankylosis has always resulted. If one secures a permanent abduction of thirty to forty-five degrees, as may be accomplished always by this method, the range of usefulness of the arm is greater than when the humerus is parallel with the posterior border of the scapula.

The author feels that the directness and simplicity of the operation, its ease of execution, the short time required to perform it, and its guaranty of practically certain results fulfill all the requirements that may be demanded of any surgical operation.

SUBTROCHANTERIC OBLIQUE OSTEOTOMY IN COXA VARA, WITH TEMPORARY EXTERNAL FIXATION OF THE FRAGMENTS

BY DR. CHARLES LASSERRE, BORDEAUX, FRANCE

Chirurgien de la Clinique Infantile de Bordeaux-Bastide

It has been shown that in the child arthrodesis, aided by external and temporary fixation, is preferable to osteosynthesis with a loss of material, and the reason for this has been very well demonstrated by Prof. Ombredanne, whose opinion is supported by our own experience. The operative correction can be judged with mathematical precision, and the application of the plaster apparatus is usually sufficient. We have used this method following osteotomy in a case of infantile coxa vara, and we are reporting our observation, not to emphasize the operative indications but to describe more definitely certain details of technique.

The case was of a child of six years, with a congenital luxation of the left hip; the limp resembled that which is usually seen in this affection; abduction of the limb was difficult, and there was a shortening of three centimeters; the radiograph showed a flexion of the femoral neck of about seventy degrees. There was seen a noticeable thinning of the cartilage of the joint, with irregularity of the bony contour. The elevation of the greater trochanter was not very considerable, but the x-ray (Fig. 2) shows

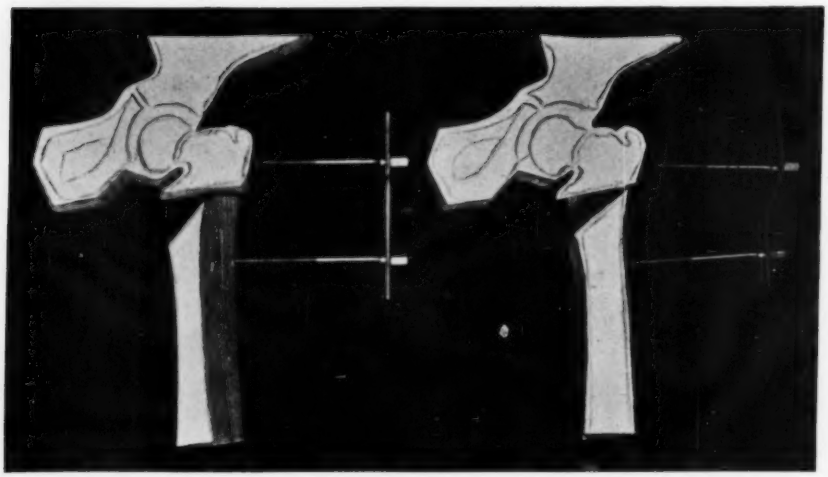

FIG. 1

Drawings showing the correction and fixation of fragments, after oblique subtrochanteric osteotomy. Right: correction of the angle of the neck and shaft. Left: correction of the angle of the neck and shaft, and of the external rotation.

FIG. 3
After operation. Radiograph taken through plaster.

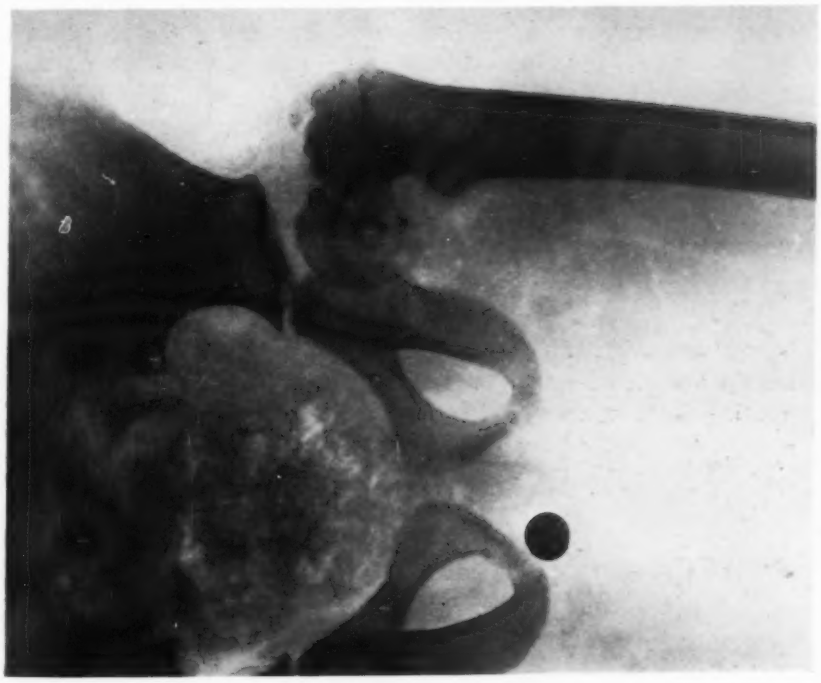

FIG. 2
Before operation.

the flexion of the neck and the adduction of the diaphysis to be the most striking features. As the family were desirous of an improvement in the gait and a correction of the attitude, a subtrochanteric osteotomy was done.

After exposing the greater trochanter and stripping the periosteum, an oblique osteotomy under the two trochanters was performed. A previous tenotomy of the adductors permitted the leg to be brought into marked abduction. Before the osteotomy a fixation screw of Ombredanne had been inserted obliquely at the level of the diaphysis of the femur, in a position already determined by the radiograph. This last detail of technique is of importance, because the inclination of the screw, so placed as to protrude to the outside, definitely indicates the correction to be obtained. After the osteotomy a second screw is placed in the direction of the neck, at the level of the greater trochanter. The beveled extremity of the inferior fragment is placed into a notch of the superior fragment, and the two screws constitute an excellent means to determine and to fix the correction. The upper screw admits the lowering of the greater trochanter; it is then only necessary to unite the screws by some means of external fixation, which prevents that secondary displacement which is always possible in sections of bone of small diameter.

In this case the operation was easily completed, and the plaster was immediately applied from pelvis to foot. The screws were removed on the twentieth day; cicatrization occurred in the usual time. The plaster was removed in two months; the consolidation was perfect, and the patient at once began to walk. The attitude of adduction had been corrected, and the shortening was but one centimeter; however, the wearing of orthopaedic apparatus for a matter of support during several months was advised.

The temporary fixation is a definite aid in the oblique subtrochanteric osteotomy. It permits one to determine the amount of correction, if necessary under radiographic control, and also to obtain with certainty the necessary sufficient fixation, for the reason that the superior fragment, cervico-trochanteric, is influenced by the muscular groups which are inserted at its level. The support of the beveled inferior fragment under the trochanter also allows the correction of an external rotation, when such exists.

The subtrochanteric oblique osteotomy becomes a logical operation, which has the definite advantage, when the fragments are held well in place, of overcoming the shortening, at least to a degree.

THE MECHANICS OF AMBULATORY TREATMENT OF FRACTURES OF THE CLAVICLE

BY CHARLES S. YOUNG, M.D., LOS ANGELES, CALIFORNIA

The problem of maintaining apposition and alignment of the fragments following reduction of a fractured clavicle has always been difficult. Many surgeons believe that recumbency in the supine position is necessary to maintain good position, for the weight of the upper extremity and tensile stresses produced by muscular action are largely eliminated in this position. For obvious reasons it is desirable for patients to be ambulatory. This study was made in an effort to obtain an efficient, comfortable, and easily applied means to accomplish this. It seems that the age-old saying "pulling one's self up by the boot-straps" may well apply to the mechanics of the customary and conventional methods that are in use.

The clavicle in its function as a compression member normally resists the forces exerted by the muscles which act on the shoulder girdle. The rigidity of the bone allows an interplay between the elevators, depressors, the muscles working in the horizontal plane, and the force of gravity. This rigidity acts as an equilibrant to maintain equilibrium for these non-coplanar, non-concurrent, and non-parallel forces. The muscular action is not exerted as a continuous force, for any or all of the muscles may be relaxed.

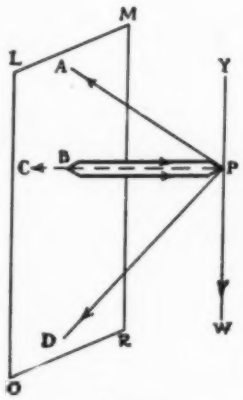

FIG. 1

Graphic representation of forces acting on lateral extremity of left clavicle, anterior view.

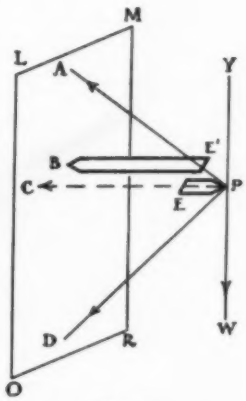

FIG. 2

Graphic representation of forces after complete oblique fracture of left clavicle at junction of middle and lateral thirds, with displacement of lateral fragment.

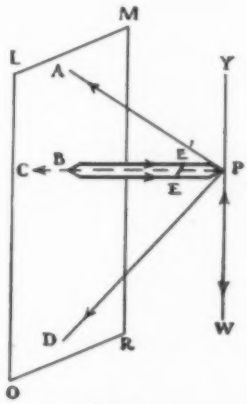

FIG. 3

Essential extrinsic force *W P* which is necessary to maintain reduction, indicated graphically.

In ordinary posture with the body erect, there are three chief forces concerned in maintaining the position of the clavicle. These are the forces exerted by the group of elevator muscles, the weight of the upper extremity, and the reaction in the rigidity of the bone itself. During the use of the shoulder girdle in this position, all or any combination of the intrinsic forces capable of acting on the clavicle may be active.

FIG. 4

Apparatus consisting of a rigid metal strip, bent to allow the occiput to project posteriorly, suspended between wooden blocks.

FIG. 5

Sheet wadding covering stockinet. Felt pads under back, over iliac crests, anterolateral surface of thorax, and inferior to olecranon.

FIG. 6

Inserting extra felt pad between stockinet and original felt over crest of ilium on affected side.

After a fracture there is considerable change in the forces which are necessary to maintain equilibrium. Following reduction of incomplete fractures, complete transverse fractures with interlocking serrations, and

FIG. 7

Completed cast. Attention is called to molding-in over iliac crests.

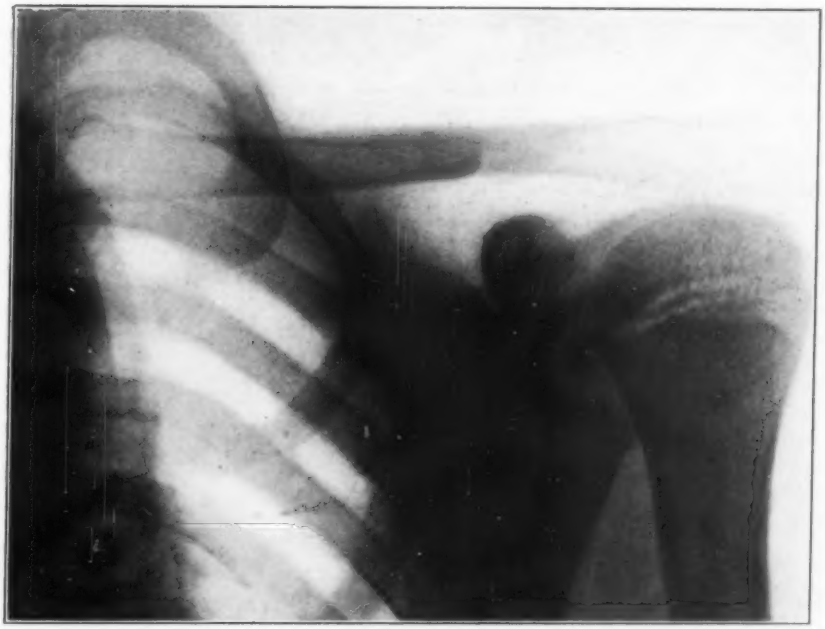

FIG. 8

Case 1. Complete fracture with lateral fragment overriding anterior.

FIG. 9

Case 1. One month postoperative, before removal of plaster jacket. Beginning absorption of beef-bone graft.

after internal fixation in complete fractures, partial rigidity of the clavicle results; so that its reaction to longitudinal tensile stresses is largely restored. However, lateral stresses produced by the weight of the upper extremity and muscular action are not resisted sufficiently in some cases to prevent displacement or angulation of the fragments. An extrinsic force or forces must be applied to maintain equilibrium.

After reduction of complete oblique fractures without internal fixation, there is no provision for reaction to longitudinal tensile stresses, because the adjacent fracture surfaces of the bone are not perpendicular to these forces. As an alternative in these cases, traction on the lateral fragment would be required. Such traction theoretically would be from a point lateral to the acromial extremity of the clavicle in the longitudinal axis of the bone. Obviously skeletal traction is impractical. Traction made on the arm and forearm must be transmitted from the ligaments of the shoulder joint to the scapula and from the latter by its ligamentous attachments to the lateral extremity of the clavicle. Such traction is from a point inferior to the clavicle and cannot be in a line with its axis.

Considering the foregoing analysis, an ambulatory splint for fixation of a fractured clavicle after reduction may be used for the following:

1. Incomplete fractures.
2. Complete transverse fractures with interlocking serrations.
3. Complete fractures with internal fixation.

FIG. 10

Case 1. Fourteen months postoperative. Complete absorption of graft. No superior angulation or depression of lateral extremity of clavicle.

It may also be used for unreduced complete oblique and transverse fractures with overlapping, in patients who are not good operative risks, to maintain parallel alignment of the fragments.

For simplicity the common type of simple complete fracture in which the fracture is at the junction of the middle and lateral thirds should be considered. Here the fracture line is usually directed from the superior surface, inferiorly and medially. The medial fragment is not changed in position to any practical extent, for there is no great change either in direction or magnitude of the forces acting on it. However, in some cases this fragment is elevated by the thrust of the lateral fragment. The lateral fragment is displaced in an inferior, medial, and anterior direction by muscular action and the weight of the upper extremity. We are concerned chiefly with the forces acting on this fragment.

FIG. 11

Case 1. Eight months postoperative.

A MECHANICAL EXAMPLE—NORMAL

Graphically, Figure 1 can be used to demonstrate the problem as stated in the foregoing, with the body erect.

The mid-sagittal plane of the body is represented by the quadrilateral *OLMR*. The compression member *BP* corresponds to the left clavicle, anterior view, *B* corresponding to the medial extremity and *P* to the lateral extremity of the bone. Each muscle group is represented by the resultant of the tensile forces produced by its individual muscles. The member *AP* corresponds to the elevators of the lateral third of the clavicle, the member *CP* to the resultant of muscles acting in the horizontal plane, *DP* to the resultant of the forces produced by the depressor muscles, while *W* refers to the weight of the upper extremity. In the mechanical example, we may assume that the tensile forces in members *CP* and *DP* are inactive. Then the point *P* is in equilibrium under the actions of the load, *W*, and the member *AP*, and the reaction of the member *BP*. We have now a system of coplanar and concurrent forces.

A MECHANICAL EXAMPLE—AFTER FRACTURE

Figure 2 indicates that the compression member *BP* is broken. This results in a loss of its reaction so that the member *EP* is displaced by the forces *AP* and *W*, in the direction of *C* and *W*.

For restoration of the original state of equilibrium (Fig. 3), the compression member BP must have its segments BE^1 and EP restored to their original positions. If these are fixed securely, there is no need for application of extrinsic forces to maintain position. However, we must assume that fixation is not so complete as it was before continuity was lost. It follows then that any unbalance in the forces acting on the point P will serve to dislodge the segment EP. The principle force is the load W which does not have an opposing force in the direction PY. Therefore, a force necessary to resist displacement of EP must be a force equal to W, applied in the opposite direction.

APPLICATION OF MECHANICS IN TREATMENT

In actual treatment after reduction of the fracture, the extrinsic force used—as indicated graphically in the mechanical problem Figure 3—to resist the dislodging effect of the weight of the upper extremity, must extend from the crest of the ilium, because it is the only relatively fixed point inferior to it. From the crest of the ilium as a base, the force may be applied successively from: first, the posterior border of the olecranon process of the ulna with the elbow flexed; second, the humerus in its longitudinal axis; third, the scapula and its acromion process. The use of a brace for this purpose is impractical on account of the requirement of accurate and individual fitting to the body contours in an emergency, and the difficulty

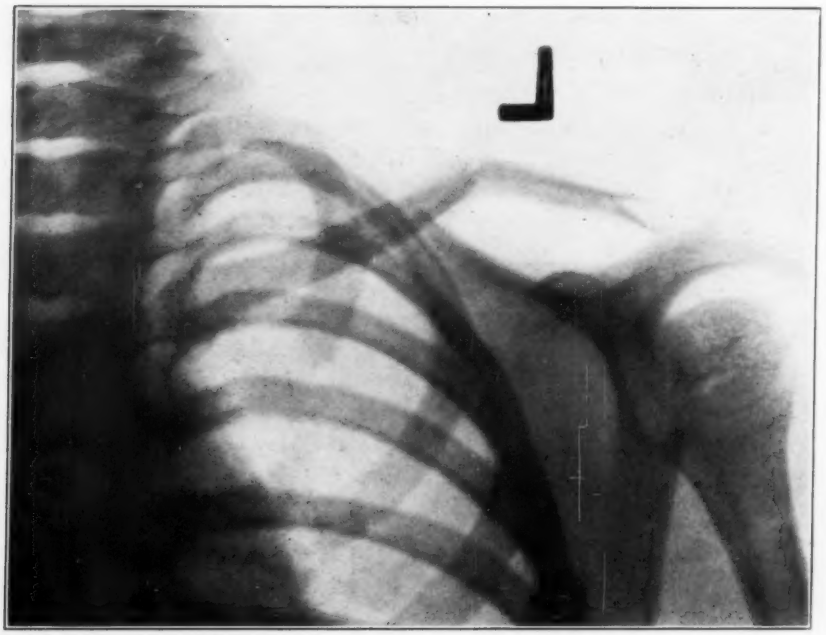

FIG. 12

Case 2. Incomplete fracture with usual angulation of fragments.

FIG. 13

Case 2. Four days following reduction, showing position in plaster jacket.

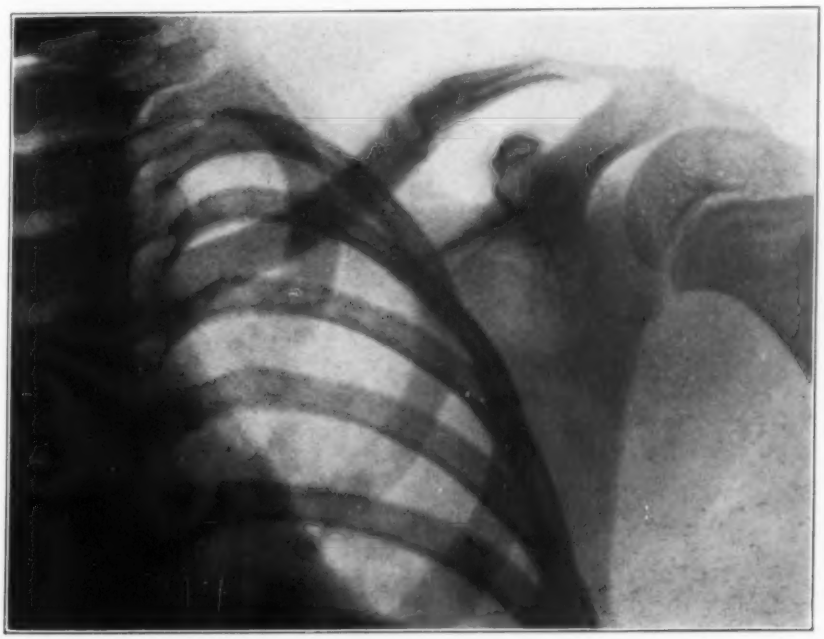

FIG. 14

Case 2. Five months after reduction.

in spreading pressure on skin areas. A plaster-of-Paris cast fulfills all the requirements, for it can be made to fit accurately, so that positive pressure is spread sufficiently on skin areas to prevent surface reactions. The rigidity of the cast, when well fitting and molded to the surface contours, will prevent movement of the lateral extremity of the clavicle by the various muscle groups.

A METHOD OF APPLYING THE PLASTER JACKET

The plaster is applied most conveniently with the patient in the supine position. Stockinet is placed over the trunk and upper extremity before reduction of the fracture to avoid excessive handling. After reduction the patient is elevated on a strip of thin rigid metal which has been bent to allow the occiput to project posteriorly (Fig. 4). This metal strip extends along the spine from the occiput to a point inferior to the trunk and is suspended between two rectangular blocks of wood, one opposite the patient's head, the other opposite the hip joints. The long dimension of the wooden blocks should be approximately the width of the operating table, and their cross dimension should be sufficient to allow plaster bandages to be readily passed under the patient's body. Pillows are placed under the patient's thighs and legs to keep them on a level with the trunk, so that the hips will not be hyperextended with a resulting lordosis. Sheet wadding bandages are used to cover the stockinet (Fig. 5). A large felt pad one-half inch thick is placed under the back from the mid-sacrum to the seventh cervical spinous process. Wide felt pads are placed over the anterolateral surfaces of the body from a point inferior to the anterior superior spine of the ilium to the sixth rib. The surgeon should support the affected upper extremity, directing the shoulder girdle in a superior and posterior direction. Theoretically the humerus should be at the side of the body with the shoulder joint in a neutral position. This presents technical difficulties, however; so that the shoulder joint may be flexed fifteen degrees, abducted twenty-five degrees, and rotated inward ten degrees to facilitate the application of the cast, as well as to make it more comfortable to the patient. The elbow is flexed ninety degrees. As the plaster bandages are applied they should be molded in well over the iliac crests and anterior to the shoulder

FIG. 15

Case 2. Nineteen months after reduction.

FIG. 16

Case 3. Common type of complete fracture.

girdles. A plaster strut should extend between the cast at the elbow and the jacket. After the cast has partially dried and before the patient is allowed to sit up or stand, a thick piece of felt should be inserted between the stockinet and the original felt over the crest of the ilium on the affected side (Fig. 6). This will insure a proper elevation of the cast, so that it cannot slip down and act as a destructive force instead of an assistive force. To judge this requirement at any time during healing of the fracture, one can palpate the clavicle on its superior surface to make sure that the cast is not bearing down on it. More felt may be inserted if necessary to keep the cast elevated sufficiently. An opening may be made over the epigastrium (Fig. 7) for abdominal expansion during respiratory movements.

In the past two years, since working out the problem as described, the writer has treated ten patients with fracture of the clavicle. Four of these were incomplete or green-stick, while the others were complete fractures. Internal fixation by means of intramedullary beef-bone grafts was used in the latter. The patients were allowed to be ambulatory as soon as the casts were partially dry, on the second or third day following their application. There have been no particular complaints in regard to discomfort, and very little inconvenience has been experienced by the patients. The first patient, after application of the cast, while playing with other children, climbed a stone wall several feet high and fell to the ground. The cast was partially broken through at the wrist, but the fragments of the clavicle were not disturbed.

The final result in these cases has shown no superior angulation of the fragments with depression of the lateral extremity of the bone. In one case the force exerted by the cast was made too great, for a loss of the normal angulation with elevation of the distal extremity of the clavicle resulted.

Only three case reports are given because there has been no great variation in physical and roentgen findings or in the treatment and results.

CASE REPORTS

CASE 1. (Figs. 8, 9, 10, and 11.) G. M., school boy, aged eleven years and nine months, admitted December 14, 1928.

Physical examination: Shortening and depression left shoulder. Loss of continuity and preternatural mobility at junction of middle and lateral thirds of left clavicle. Palpation revealed lateral fragment to be overriding medial fragment anteriorly. No crepitus. Roentgenogram showed oblique fracture of left clavicle at junction of middle and lateral thirds. Overriding of lateral fragment anteriorly about one and five-tenths centimeters.

Diagnosis: Complete oblique fracture of left clavicle, junction of middle and lateral thirds.

Operation, December 15, 1928: Open reduction. Intramedullary beef-bone graft. Immobilization by plaster jacket.

Result, February 6, 1930: Left shoulder showed no shortening and was maintained slightly higher than right. Roentgenogram showed nearly normal contour of bone with complete absorption of intramedullary graft.

CASE 2. (Figs. 12, 13, 14, and 15.) B. L., aged two years and six months, admitted April 3, 1929.

FIG. 17

Case 3. Four days postoperative.

FIG. 18

Case 3. Eighteen months postoperative.

Physical examination: Superior angulation of left clavicle at junction of middle and lateral thirds. Roentgenogram showed incomplete fracture of left clavicle at junction of middle and lateral thirds with superior angulation at fracture line.

Diagnosis: Incomplete fracture of left clavicle.

Operation, April 4, 1929: Closed reduction by manipulation. Immobilization by plaster jacket.

Result, September 3, 1929: Shoulders were symmetrical. Palpation of left clavicle showed no abnormal angulation.

CASE 3. (Figs. 16, 17, 18, and 19.) D. C., aged three years and nine months, admitted May 9, 1929.

Physical examination: Right shoulder depressed and shortened. Palpable loss of continuity in clavicle at junction of middle and lateral thirds. Lateral extremity of medial fragment palpable. Fractured end of lateral fragment covered deeply by soft parts. Roentgen findings showed a complete oblique fracture of the right clavicle at the junction of middle and lateral thirds. Lateral fragment displaced in an inferior and medial direction. Lateral extremity of medial fragment displaced upward.

Diagnosis: Complete oblique fracture of right clavicle, at junction of medial and lateral thirds.

Operation, May 10, 1929: Open reduction. Intramedullary beef-bone graft. Immobilization by plaster jacket.

Result, December 6, 1930: Right shoulder showed no shortening. Palpation of the right clavicle did not show angulation. The left shoulder was main-

FIG. 19

Case 3. Eighteen months postoperative.

tained slightly high because the patient is a cerebral palsy case with left spastic hemiplegia.

CONCLUSION

1. The plaster jacket may be used to immobilize and give positive support to the fragments after reduction of fractures of the clavicle.

2. This method requires more time for its application than splints and other apparatus, but this disadvantage is offset by the small amount of attention which the patient requires in the follow-up treatment.

3. The cast is comfortable and allows recumbency for sleeping in the supine position, on the side, or in the prone position with the arm over the side of the bed.

4. The patient may be ambulatory with an assurance to the surgeon that any movement on the part of the former will not disturb the position of the fragments.

NOTES ON FOOT DISORDERS AMONG NATIVES OF THE BELGIAN CONGO

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One of the objectives of the recent African expedition undertaken by Columbia University and the American Museum of Natural History, New York, was a study of the feet of the native African. Such observations were desired for comparison with the feet of shoe-wearing city dwellers, because, owing to advancing changes in habits of primitive peoples, opportunities for study of the natural unshod foot will be increasingly difficult to obtain. The African continent is rapidly becoming industrialized, especially along the coast and well up the larger rivers such as the Congo. With the steadily progressive advent of American and European commercial enterprise, the habits and modes of civilization have affected native life. This is conspicuously the case in the adoption of the white man's wearing apparel. At present, shoes and other articles of white man's clothing are worn mainly as a matter of pride which the native feels in his possession of them, and the sense of superiority it affords him over his fellows. About seaports and larger towns, the native use of clothing follows somewhat more conventional lines; but in outlying districts where contact with the whites has been more recent and infrequent, very strange and incongruous effects are often met with.

When a native is fortunate enough to acquire a pair of shoes, he wears them, not from a standpoint of protection or utility, but purely to satisfy a very general and primitive emotion of personal vanity. The proper fitting, or even proper pairing, of shoes plays no necessary part in their use. One rarely sees a shod negro laborer or house-boy whose shoes fit his feet. Indeed, the majority of shoes worn by natives have been either given by, or otherwise acquired from, their white employers. These remarks do not apply to that class of negroes who have been for a long period in contact with the whites, and have attained responsible clerical and commercial positions, as particularly observed in the west coast towns.

In outlying districts, however, such as the areas of the eastern plateau, footwear is an extreme rarity, and may be regarded as practically unknown; here, never having as yet worn shoes at any time in their lives, the natives afford excellent opportunity to study the human foot under purely natural conditions and unmarred by the use of shoes.

In fact, from the standpoint of protection, it might be said that some adequate type of foot covering would really be advantageous to the natives in order to reduce hookworm infection, chigger infestation, and injuries to the toes and foot.

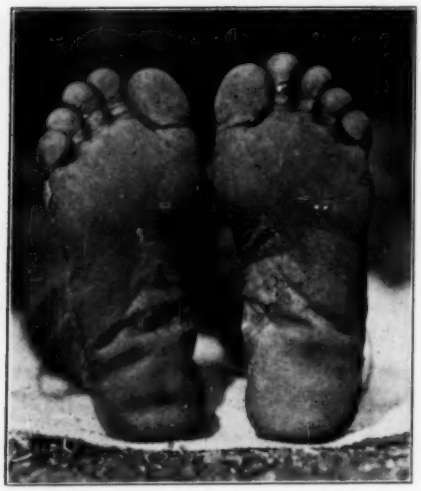

FIG. 1

FIG. 2

The course of the expedition led across Central Africa from east to west. Foot studies were first made of natives in the mountainous regions of eastern Belgian Congo and within the environs of Lake Kivu and Lake Tanganyika; they were continued among natives along the middle and lower Congo River areas. These studies included the use of still and motion pictures and of a kinetographic footboard which had been specially designed and previously used by one of us for analysis of foot mechanics and gait. The functional aspect of this problem will be given from detailed studies of these records in later publications, the purpose of this paper being to give only our observations of the most common types of foot trouble which affect these primitive people.

Conditions of life among the negroes of the interior have a very definite bearing upon their foot disorders. In this connection the extraordinary thick, pachydermatous skin on the sole of the foot is worthy of comment (Figs. 1, 2, and 3). Since these individuals have from their earliest years been living in rough, hilly, and mountainous country with no foot protection whatever, the keratinized layer becomes very thick and tough. Some idea of the thickness and stiff, leather-like character of the skin of the sole may be gained from the photographs, by the depth of the sharply defined transverse creases immediately behind the ball of the foot, and by the shallow but heavy wrinkles under the arch.

It is not an uncommon thing in the colder areas of the Congo to see negroes sitting for some time at a small outdoor fire with their feet resting on live coals. When requested to do so, our porters would not hesitate to walk through a bed of live coals, apparently experiencing no discomfort whatsoever.

It might also be mentioned how wrinkling of the skin about the ankles seems to vie with facial wrinkles in natives over forty years of age (Fig. 4).

Signs of senility develop quite early in the bush native, especially the females; they are old women at the time the European is just approaching middle age. It is unusual for the male negroes in the areas visited to develop obesity, and the notable wrinkling about the ankles as a sign of age is obviously due to disappearance of subcutaneous fat which is present in younger individuals and contributes to their remarkably graceful body form.

Another superficial character frequently observed in both young and adult individuals is a reduction in the usual size of the toenails, especially that of the great toe. A conspicuous example of this condition is shown in Figure 5; it may also be seen in some of the other photographs.The portion of the nail remaining becomes quite thick and cornified. Although the "chiggers" which are discussed later might in some cases account for this apparently impaired growth of the toenails, according to the little information that could be gathered from the natives, the condition may more properly be regarded as due essentially to attrition, resulting from striking the toes against obstacles, and other mild injuries.

In so far as actual ailments and deformities of the feet are concerned, the most conspicuous and frequent type is absence or deformity of one or more toes. The great majority of these have been acquired through infection of some kind. Clinical histories of these cases were very obscure and difficult to obtain, due to the inadequate knowledge of the native languages on the part of the investigator. Naturally, the results were obvious, but under the circumstances the primary cause of the defects was not easy to determine.

Among the natives the loss of toes is more or less comparable in frequency with static disorders of the feet among our city dwellers. Where we suffer from arch strains, they lose a toe or two. Observations made during the course of the trip substantiate earlier reports that African natives are notably free from the ordinary types of static foot trouble with which we are so familiar in our civilized centers of population. Although their un-

FIG. 3

FIG. 4

FIG. 5

shod feet give the impression of having lower arches generally than the feet of white races, the range of arch *height* seems to be about the same in both groups. Pronation is not a common condition; their legs are well positioned above the feet, insuring an even distribution of body weight upon the latter.

The chief source of foot trouble among these Africans is infection, microbic or parasitic. Any traumatism or injury of the toes develops a secondary infection which the native has no idea how to treat. If it pains him, he covers it, but primarily as a means of protection rather than as a surgical dressing.

Although in some parts of Africa, ainhum (Dactylolysis spontanea) is responsible for loss of toes, and most frequently the fifth toe (only ten per cent. of the cases involving the other four toes, according to Castelloni and Chambers), there was only one instance seen during the expedition in which it seemed probable that the deformity was due to this cause. Ainhum is of known origin. Its pathology comprises a slow constricting ingrowth of epithelium at the base of the toe, ultimately effecting a complete amputation. It is confined to tropical countries and apparently affects only the natives.

The two most frequent types of specific infection are the "chigger", which directly involves the toes and foot (Dermatophilus penetrans) and

FIG. 6

FIG. 7

"yaws" (Treponema pertenue). Both of these conditions were encountered quite frequently.

The "chigger" was introduced into the west coast of Africa from the Americas as recently as 1872, and is now abundant throughout Central Africa. This sand flea is regarded by many of the physicians in charge of native hospitals as being the primary cause of many ulcerated toes and their ultimate loss. As is well known, the gravid female of the species burrows into sweat glands between the toes, along the edge of, or under, the nail, and there deposits her eggs. Natives were frequently seen sitting about, picking at their toes with a thorn, a piece of glass, or a knife blade in an effort to remove the parasite. Even though the insect and eggs are removed, it is obvious that under such conditions a focus very favorable to secondary infection remains. Even the majority of Europeans in these districts are from time to time infected by "chiggers", as also were members of our party. Consequently, since shoe-wearing is shown not to be sufficient protection, it is obvious that infection must be very general among barefooted natives.

Chesterman[1] stated that ninety-five per cent. of the native population around Stanleyville, through which our expedition passed, acquire yaws before puberty. The ulcerations caused by this parasite are well known, and are extremely common in all districts. In Figure 1 the beginning of an ulceration, probably of this nature, can be seen at the base of the distal phalanx of the second toe of the left foot. Rarely are such ulcerations given an opportunity to heal. They are not dressed nor bandaged, and are subject to constant irritation. Sometimes, when the erosion becomes more extensive and causes pain the native covers it with a rough bark bandage, or one made from green banana leaves. Usually the erosion continues until the toe is entirely lost.

Other types of tropical phagedenic ulcers of the feet prevailing in

FIG. 8

FIG. 9

FIG. 10

Africa were undoubtedly mingled with the cases we saw. There was no opportunity, however, to study them from a differential and bacteriological viewpoint, as was done by the members of the Harvard African Expedition (Strong[2]). In the well-documented volumes reporting their findings, many of the pathological conditions seen by our group are discussed and illustrated. They do not, however, place emphasis upon the loss of toes as a prevailing deformity which appeared to be so common in the areas visited by our party, probably because they were chiefly concerned with the primary lesions.

These toe deformities were predominantly of an acquired nature. They consist chiefly of absences and retractions following some type of ulceration or destructive infections. Two cases, shown in Figures 6 and 7, also 8 and 9, are examples of such absences. In the first case the second and fourth toes of the right foot had been lost with no apparent damage to the corresponding metatarsals. In the second case, the fifth toe of the left foot is missing and a marked lateral spreading of the second, third and fourth toes is shown. Here also the metatarsal bones seemed unaffected upon palpation, although the shape of the foot appears as if the distal end of the fifth metatarsal had been destroyed. No apparent interference in function of the foot, however, has followed the loss of the toes.

Retraction of the toes as a result of destructive inflammatory conditions is well shown in Figures 10, 11, and 12. The first individual gave the story of "a great soreness in the foot" when a boy. It resulted in a rigidly retracted toe displaced well above the normal position for the head of the fourth metatarsal bone. Lack of x-ray facilities prevented a definite interpretation of the extent of bone destruction, although physical examination indicated that the distal end of the fourth metatarsal bone was missing. The second indi-

FIG. 11

vidual showed a similar condition, but without the rigidly fixed displacement of the former.

FIG. 12

Congenital deformities are represented in Figures 3, 13, and 14. Figure 3 gives an example of bilateral absence of the fourth toe, while the others are instances of bilateral imperfect development of the fourth digit. In all three of these cases there seemed to have been a corresponding retardation in growth of the metatarsal bone; but again the lack of x-ray facilities prevented a more accurate record. Of the congenital types of deformity encountered during the journey, the fourth digit and its metatarsal seemed to be the member most susceptible to anomaly of this sort.

A review of the observations made on this expedition seems to indicate that the foot problem from an orthopaedic standpoint is not an urgent one among natives. The flat-footed condition among the negroes of our country, which is sufficiently common to give it repute as a racial character, would seem to find its origin in some locally developed diathesis of a rachitic nature, for no such imputation could be ascribed to the posture and contour of the feet of those primitive people with whom the expedition had contact. Their foot trouble was chiefly of surgical types, a primary traumatism in some cases, but essentially infection (primary, secondary,

FIG. 13

FIG. 14

or mixed) in the vast majority. Congenital deformities of a mild nature, as of the toes, were occasionally recognized, but no example of congenital club-foot was seen throughout the trip, although a great many thousands of natives came under our general observation. Likewise, major amputations of the lower extremity were never seen by us in the interior. Obviously native life has no place for the survival of those unfortunates who are born with, or acquire, so severe a physical handicap.

Although the African natives present so little to the orthopaedic surgeon in the way of static disorders of the feet, it is expected that the records made will yield valuable information to help us understand better these disorders as they prevail within our more artificial environment of city life. The native feet which were studied have not been affected by shoes or footwear, nor has the use of their feet been influenced by theoretical recommendations or suggestions of how this should be done. In other words, the result is a purely native product, and in its analysis we may hope for information which will lead to a clearer comprehension of the natural mechanism of the foot and help toward a better understanding of the foot troubles of our own people.

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EPITHELIZATION OF CANCELLOUS BONE IN OSTEOMYELITIS*

(Another Cause of Persistent Drainage)

BY J. E. MILGRAM, M.S., M.D., IOWA CITY, IOWA

The literature of chronic draining sinuses leading into bone deals for the main part with procedures designed to eradicate the offending channels.

The case reported here, aside from the clinical interest attaching to the probable explanation of why a local osteomyelitis should have persisted sixty-two years, is unique to our knowledge in that stratified squamous epithelium grew down a chronic sinus tract into an infected marrow cavity and there proliferated benignly but widely so as to replace the usual granulation tissue in a large area of chronic bone destruction. This report is prompted by the fact that no similar observation appears to have been recorded, and that the significance of such pathology in the healing of bone cavities is not recognized. It is probable that in lesser degree epithelization of old bone cavities is not uncommon.

CASE REPORT

History: A white male, aged seventy years, unmarried, entered the Orthopaedic Service of the State University of Iowa with a draining sinus in the left hip region. Since the age of eight years there had existed a sinus in this region constantly discharging purulent fluid. He was unable to recall the details of the onset.

For the past fifty years he had worn a raised shoe because of shortness of the limb. In spite of continuous daily discharge, he had been able to continue farming all through boyhood and manhood up to six months prior to admission, when the hip commenced to ache. Three weeks before admission, a new sinus appeared below the original sinus.

Examination: A thin, elderly male; impressed one as not being particularly ill. With the exception of palpable hardening of the brachial and radial arteries, interest attached itself only to the region of the left hip. The femur was fixed to the pelvis by apparent bony fusion in the position of twenty degrees adduction and thirty degrees flexion. Actual shortening of the extremity was three inches. On the outer aspect of the thigh were numerous well healed scars. Directly over the greater trochanter was the mouth of the old sinus tract one-half centimeter in diameter, firmly fixed by scar tissue to the deeper structures, and lined with a greenish, slimy membrane. Two inches below it was the apparently new sinus whose walls were moderately soft, discharging pus whose odor was suggestive of bacillus pyocyaneus. The urinalysis showed no departure from normal. The red blood cells were 4,200,000. The hemoglobin was seventy-five per cent. (Sahli). There were 9,000 white blood cells with seventy-five per cent. neutrophils and no abnormal cells. The temperature ranged between 94.8 and 100.8 degrees. The pulse rate averaged ninety-two and the respirations twenty-four per minute. The blood pressure reading was 150/68. The Wassermann reaction was negative. Intradermal tuberculin tests were positive. Culture of wound discharge revealed bacillus pyocyaneus.

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Hospital course: Six days after admission, the patient was operated on. The sinuses were connected by a four-inch incision which was carried down to the femur. The upper sinus led directly into a large abscess cavity in the greater trochanter. The adjacent cortex was ivory hard. A window three inches long and one inch wide was cut in the upper end of the femur. The marrow was peculiarly gray and soft in texture over this region. But little cancellous bone was present. Large masses of this unusual appearing marrow were removed with the curette. The area of shaft destruction led to the site of the former hip joint which was similarly filled with this gray friable tissue. Vaselin gauze was packed into the cavity, and dressings applied. It was felt the extensive bony ankylosis would enable the patient to dispense with cast immobilization.

Operative Specimens: Grossly, they consist of multiple small pieces of bone. The cortex is thickened and is ebonized. The marrow is softened and contains considerable gray granulation tissue.

Microscopically, the sections for the most part consist of stratified epithelium and granulation tissue, in the center of which small spicules of bone are visible. The epithelium is very abundant, grows irregularly, but has everywhere a very distinct basement membrane. Little keratinization has occurred. No mitoses are seen. The epithelium in places is in contact with bone trabeculae. In some regions the bone cells stain well; but for the most part, the trabeculae seem necrotic and between the bone and epithelium in most areas is a dense layer of leucocytes. In some regions granulation tissue is fairly abundant, but in most, epithelial masses predominate. There is no foreign-body reaction or evidence of tuberculosis. There is no evidence of malignant alteration of the epithelium.

FIG. 1

Roentgenogram on admission. Sclerosis marked. Sinus apparent on anterolateral aspect of femur.

FIG. 2
Stratified squamous epithelium in marrow cavity. (Low power.)

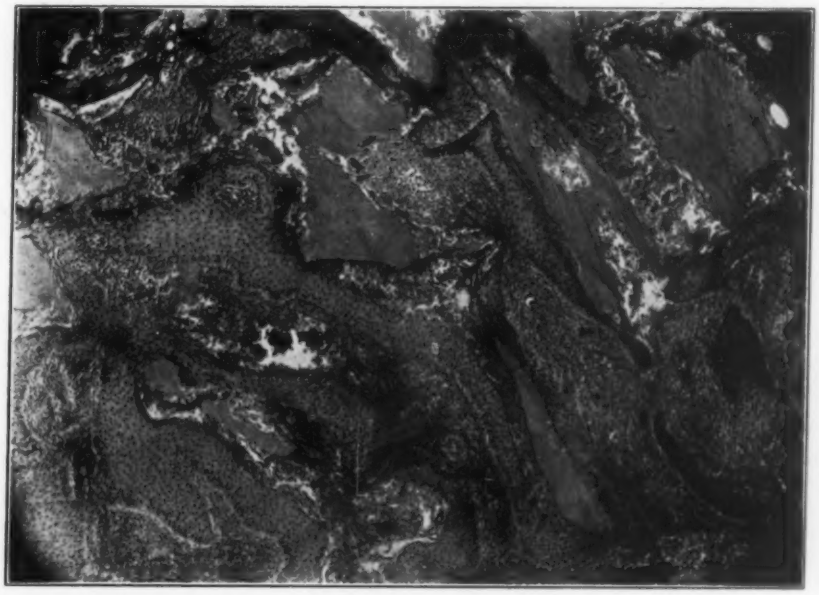

FIG. 3
Stratified squamous epithelium surrounding bony trabeculae. (Low power.)

Subsequent course: Two weeks after operation, the patient, while turning in bed, fractured the femur at the operative site. He was thereafter confined to bed continuously and slowly deteriorated in spirits and strength. Drainage (bacillus pyocyaneus by culture) continued profuse. No evidence suggestive of metastasis was found. The patient appeared to be slowly growing weaker. Seven months after operation, the patient, still bed-ridden, commenced to run a temperature to 104 degrees and after two or three days of unusual weakness, died. The clinical antemortem diagnosis was sepsis.

Necropsy: The post mortem examination was performed twenty-eight hours after death, May 8, 1929.

The *left lower extremity* is freely movable in all directions, hinging at the upper part of the femur. The thigh and leg are much smaller than the corresponding parts on the right. There are numerous healed scars on the outer aspect of the left thigh. There is a draining sinus over the left greater trochanter, measuring three and five-tenths inches in length. This sinus is lined by a green membrane. The upper end of the femur and hip joint are exposed by an incision over the left lateral side. A portion of the upper end of the femur is removed along with two of the sinus tracts, the lower one of which is healed. The upper sinus extends into a cavity in the region of the former hip joint which measures roughly six centimeters in diameter. The inner wall of this cavity is formed by a concavity in the ilium, which is in the proper anatomical position for the acetabulum. At the upper margin of this cavity is soft spongy bone which is easily chiseled out and seems to be a part of the ilium. In the lower end of the cavity is found the upper end of the femur. The head, neck, and greater trochanter are made out as definite structures. The outer wall of the cavity blends with the sinus tract. The whole cavity is surrounded by

FIG. 4

Epithelium in contact with cancellous bone. High power magnification of field in Fig. 3. Intercellular bridges are visible.

dense fibrous tissue which resembles a joint capsule. The wall of the cavity is discolored and covered by necrotic tissue. The upper end of the femur is very irregular, and discolored. The bone is soft, and shows great destruction. It is probable that the head, neck, and greater part of the trochanter have been destroyed or removed. The shaft below this point shows thickening of the cortex, with ebonization.

Microscopic sections of sinus tract and bone show epithelization (apparently as in an attempt to cover denuded surfaces) as in the operative specimens reported above.

For the sake of brevity, the remainder of the findings at necropsy, gross and microscopic, are appended in list form:

FIG. 5

Post mortem. Sagittal section of hip region. Probe in sinus.

1. Septicaemia (Bacteriological note:—Blood culture grew a non-hemolytic streptococcus and bacillus pyocyaneus).
2. Hydrops and oedema of heart muscle.
3. Healed pneumonitis.
4. Healed pleurisy.
5. Quiescent pulmonary tuberculosis.
6. Fatty metamorphosis and cloudy swelling of the liver.
7. Arteriosclerotic kidney.
8. Arteriosclerosis.

Necropsy summary: Death in this case was the result of a generalized sepsis with an infected sinus as its origin. The body, weakened by a localized chronic bone infection of sixty-two years' duration, was unable to resist this septicaemia. A guinea-pig inoculated with tissue from the sinus tract failed to develop tuberculosis. No evidence of malignancy was found, locally or at distant points.

COMMENT

The chronic sinus, as commonly seen, is lined with necrotic tissue heavily infiltrated with mononuclear cells. Rarely does the surface epithelium extend far down the tract wall. In this patient, however, the epithelium was found to have extended down the tract into the osteomyelitic

femur and to have grown luxuriantly in the marrow spaces, surrounding bone trabeculae. In spite of the abundance of epithelial tissue and its unusual extension, there was no evidence that this was neoplastic tissue. The cells were all completely differentiated. Very little keratinization had taken place. The basement membrane was everywhere intact and distinct. No mitoses were found. Necropsy revealed no evidence of invasiveness, and confirmed the first opinion of the benignity of the lesion.

When, in the course of the osteomyelitis, the epithelium first grew down into sinus tract and marrow cavity is of course unknown. In view of the fact that the pyogenic lesion remained localized for fully sixty-two years without the sinus ceasing to drain daily, notwithstanding that the patient was in good health all this period, it seems likely that the unusual findings revealed at operation bear a large share in the failure of the femur to heal.

It appears credible that the unusual duration of the suppurative arthritis is to be attributed to the continued presence of stratified epithelium in the marrow cavity; and it is conceivable that radical removal of this tissue many years ago might have permitted the formation of normal granulation tissue in the area of destruction, with subsequent obliteration of the cavity with bone in normal fashion.

It is likely that epithelization of marrow cavities to a lesser degree is a not infrequent occurrence.

SUMMARY

A pathological lesion is described, wherein stratified squamous epithelium grew widely in the marrow cavity, and was associated with localized osteomyelitis of unusual duration. It is suggested that epithelization of the marrow cavity constitutes another cause for persistence of drainage in certain cases of osteomyelitis.

THE TECHNIQUE OF PREPARING AND STAINING LARGE BONE SECTIONS FOR HISTOLOGICAL STUDY*

BY GEORGE WAGONER, M.D., PHILADELPHIA, PENNSYLVANIA

The histological study of large bone sections has been neglected, due to the technical difficulties of preparing such sections.

While working under Prof. F. J. Lang in the Pathological-Anatomical Institute of the University of Innsbruck, Austria, the opportunity was afforded me of studying many large bone sections made by the master technician, Nikolaus Bock.

By modification of Bock's[1] original technique we have been able to cut microscopic sections of adequate thinness, eight to fifteen microns, of entire femoral heads, complete vertebral bodies, and other similarly large bony structures. The cellular elements of these sections are preserved and can be beautifully stained.

TECHNIQUE

FIXATION

The fresh bone specimens obtained either at operation or autopsy are immediately placed in from five hundred to one thousand cubic centimeters of fixative. Preference has been given to Mueller's solution**. After the specimens have remained in the solution for twenty-four hours they are taken out and cut into pieces of approximately two centimeters' thickness and in the plane or planes desired. These sections are replaced in the fixative, where they are allowed to remain for ten days. They are removed and cut into thinner sections approximately five millimeters in thickness. These sections are returned to the fixative, where they are allowed to remain for at least ten additional days. The total period of fixation, depending upon the size of the specimen, is from twenty to thirty days. A large volume of fixative is used and is frequently agitated. The positions of the sections are changed at frequent intervals during the period of fixation.

DECALCIFICATION

Two methods of decalcification have been selected following extensive trial with many.

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**Mueller's Solution

Potassium bichromate	30 Gm.
Glacial acetic acid	50 c.c.
Distilled water	1000 c.c.

Nitric acid—A five per cent. aqueous solution of nitric acid will adequately decalcify large bone specimens within twenty days. The acid is changed frequently, as are the positions of the sections immersed in it.

Formic-citrate—Formic-citrate solution consists of equal parts of: (1) fifty per cent. aqueous solution of formic acid, (2) twenty per cent. aqueous solution of sodium citrate. When this solvent is used, the solution is changed frequently and the position of the sections altered. Decalcification is complete in from ten to fifteen days. With the use of formic solution for decalcification there is less destruction of the cellular elements of the bone and less impairment of their staining qualities than result when nitric acid is used.

The stage of decalcification is tested either by needling the specimen, or better by shaving it with a sharp knife or razor. Accurate estimation of the process of decalcification may be obtained by the daily determination of the hydrogen-ion content of the solvent.

Neutralization—If decalcification has proceeded in nitric acid, the specimen is immersed in a five per cent. aqueous solution of potassium alum for twenty-four hours. This stage is omitted if formic-citrate is employed.

Washing—The decalcified bone specimen is washed with running tap water for twenty-four hours.

Dehydration—The bone is completely dehydrated by immersing for twenty-four hours in each of a number of solutions. These solutions consist of seventy per cent. alcohol, ninety-five per cent. alcohol, absolute alcohol, and three changes of ether-alcohol. The ether-alcohol consists of equal parts of ether and absolute alcohol. The absolute alcohol and ether used are kept water-free by overlaying a stratum of anhydrous copper sulphate.

Infiltration—Infiltration is with celloidin. Although the best results have been obtained with the use of Schering's celloidin, it has been too expensive for general use. Good results are routinely obtained by the use of DuPont's parlodion.

Throughout the entire process of infiltration great care must be taken to maintain anhydrous conditions. The celloidin must only be made from clean, thin, oven-dried celloidin shavings. All glassware and utensils used in the preparation of the celloidin solutions must be thoroughly dried in the hot-air oven before their use. The ether-alcohol used as a solvent for the celloidin must be anhydrous.

Five solutions of celloidin are employed. These vary in viscosity from that of No. I which is water-thin to No. V which is of the thickness of honey. Each celloidin solution is kept in an air-tight container.

The thoroughly dehydrated bone specimen is left in the first celloidin solution for three weeks. It remains in the second solution for two weeks and in each of the remaining three solutions for one week.

Evaporation—After the specimen has remained in the last celloidin solution for one week, it is overlaid by a volume of the thickest celloidin solution equal to approximately five times the thickness of the specimen.

Evaporation is now carried out very slowly and with care to avoid bubbles. The imbedding or evaporating dish is kept in a cool place. As the consistency of the celloidin increases, it is first freed from the walls of the container with a knife. Next a large block containing the specimen is outlined and as the consistency increases the block is gradually freed from the surrounding mass and from day to day turned on its various faces. When the various faces of the celloidin block are of equal consistency and the whole has the feel of dense rubber, further hardening is carried on by immersing the block in sixty-five per cent. alcohol. If the above process has been properly executed, the celloidin block will be found to be exceedingly hard and transparent. Any milkiness which may be present is indicative of the presence of water and will impair the final result.

BLOCKING

The hardened celloidin block is trimmed to desired shape, leaving a margin of at least five millimeters of celloidin about the tissue. It is mounted on a dry fiber block in the following manner:

(1) Immerse celloidin block in ninety-five per cent. alcohol.

(2) Immerse celloidin block in absolute alcohol.

(3) Immerse celloidin block in absolute alcohol and ether (equal parts) until the surface feels slimy.

(4) Submerge celloidin block in thick celloidin solution and transfer quickly to the fiber block.

(5) Allow to stand in air until a thick scum forms over the celloidin (ten minutes).

(6) Trim away excess from margin of fiber block and immerse in seventy per cent. alcohol for at least twelve hours before cutting.

CUTTING

Cutting is performed with a sledge microtome of heavy construction and long stroke. The microtome should be designed to accommodate a section whose maximum diameter is at least three and one-half inches.

Knife—A large heavy knife, the sides of which are straight and not hollow ground has been found most satisfactory. To minimize vibration it is important that the knife be securely clamped at both ends and, if possible, in the middle. The knife should be fixed at an acute angle and at least eighty per cent. of its edge used for cutting. The celloidin block and the knife must be kept thoroughly covered with sixty-five per cent. alcohol. The individual section should be removed immediately from the knife and immersed in a dish containing seventy per cent. alcohol; every effort must be made to prevent drying of the section.

It has been possible by the employment of the above technique to cut large bone sections of a thinness of three microns; the average and most desirable thickness, however, is from eight to fifteen microns.

STAINING

The cut sections are stained with Weigert's iron hematoxylin* and counterstained with eosin according to the following technique:

From the seventy per cent. alcohol in which the sections were placed when cut, the staining process continues by immersing in:

1. Water—to remove alcohol.
2. Hematoxylin—five minutes.
3. Water—to remove excess hematoxylin.
4. Acid alcohol—until celloidin clears.
5. Water—to remove acid alcohol.
6. Ammonia water—five to thirty minutes.
7. Water—dip.
8. Eosin—dip.
9. Water—to remove excess eosin.
10. Alcohol seventy per cent.—one minute.
11. Alcohol ninety-five per cent.—until celloidin clears.
12. Creosote.

Mount from the creosote in Canada balsam on clean slides and cover. The mounted section is laid on a smooth surface and a heavy weight placed on the cover slip. This weight is allowed to remain in place for two to three days or until the balsam is well set. Such a procedure aids in pressing out any wrinkles in the section and in freeing it from inclusions of air bubbles.

Lantern slides—Sections of twenty-five microns' thickness may be stained and mounted in balsam between the two glass plates of the ordinary lantern slide. The slide is then placed in the oven used in the routine paraffin technique and allowed to remain for from three to four days. At the end of this time the balsam will be quite firm and the slide is bound and the mat applied. There results from this procedure an excellent colored lantern slide of the desired section.

SUMMARY

Exact technique is given for successfully cutting and staining large bone sections of adequate thinness for histological study.

*Weigert's Iron Hematoxylin

Solution *A:*	
Hematoxylin	1 Gm.
Alcohol 95%	100 c.c.
Solution *B:*	
Distilled water	95 c.c.
Solution iron chloride	4 c.c.
Hydrochloric acid	1 c.c.

Mix equal parts of Solutions *A* and *B* each time it is to be used.

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1. Bock, Nikolaus: Eine Methode zum Studium der Ablagerungsverhältnisse der Knochensalze. Ztschr. f. wissensch. Mikroskopie u. f. mikroskopische Technik, XL, 318, 1923.

PLASTIC BONE REPAIR AFTER THERAPEUTIC IRRADIATION

Report of a Case

BY OSCAR LEE MILLER, M.D., GASTONIA, NORTH CAROLINA

A case is reported here showing impairment of bone growth after therapeutic irradiation and experience with its surgical management.

Opportunity to do plastic surgery of bones following such therapy has been somewhat limited. This may suggest that not a lot of irradiation has been prescribed in the young, or if prescribed, the lesion under treatment proved fatal or was entirely healed. Certainly, not a great deal of a practical nature has been reported on the behavior of bone tissue where plastic surgery has been required to repair defect in a sharply radiated zone.

A boy, aged seven, complaining of pain in the right leg, was admitted to a neighboring hospital, March 21, 1924. The following notes are from the case record obtained from that hospital:

"Patient, B. C.; white. *Pre-operative diagnosis:* sarcoma, tibia, right; C.C. deformity right leg. *History:* three years ago, following a fall and striking his shin, a 'lump' developed. Was perfectly well until six days ago when he jumped out of a wagon and struck his leg against a 'sleeper'. Cannot walk at all since the accident. At present the knot hurts. *Family history:* negative. *Physical examination:* Small white male child. Right tibia presents a very large, tender swelling. There is also tenderness below it. X-ray film shows large eaten-out-like appearance, and bowing of the tibia. *Operative diagnosis:* Sarcoma, right tibia (?) *Operation:* Removal of tumor from right tibia. *Remarks:* Incision was made longitudinally over the tumor mass in the middle third of the right tibia. The bone was found fractured as shown in the x-ray film. At the point of the fracture there was a tumor mass about the size of a hen's egg, which took up practically the circumference of the tibia save for a thin outer shell of bone. By means of a chisel, tibia was opened and the tumor tissue removed. It was necessary to chisel out a large opening in order to remove all the diseased tissue. All bleeding parts were controlled and several tubes of radium were inserted and packed in place. (See radium chart.) Patient stood operation well and left the table in good condition.

"*Note:* A section of the tumor mass was forwarded for pathological examination. A section examined here in the laboratory was diagnosed: spindle-cell sarcoma.

"*Progress note:* The patient left the hospital in a few days to remain under the care of family physician until the wound healed. The latter was dressed just before leaving. The wound was clean and full of packing." (Author's note: Unable to obtain exact record of amount of radiation.)

In October 1924, this patient came under the writer's observation when registered at the Clinic of the North Carolina Orthopaedic Hospital. He was on crutches and in fair general health. At the junction of the upper and middle thirds of the right leg a punched-out area existed, and from it a moderate amount of infected material was discharging. No weight was borne on the limb and there appeared to be non-union of the tibia at this level. Amputation had been proposed, but since the diagnosis might still be in question and a low-grade osteomyelitis the presenting pathology, it was decided to pursue a conservative course and watch developments. A protecting leg cast was applied and windowed for dressing.

FIG. 1

Appearance of tibia six months after debridement and irradiation.

FIG. 2

Appearance of tibia twenty months after radium therapy.

FIG. 3

X-ray of tibia showing first bone graft in place seven weeks after operation and almost three years after radium therapy.

FIG. 4

Appearance of tibia and bone graft five months after operation. Considerable absorption of the graft and non-union.

FIG. 5

X-ray of tibia after second bone graft operation. Note location of graft on the posterior aspect of the tibia and the defect anteriorly.

FIG. 6

Appearance of tibia one and one-half years after successful bone graft.

X-ray showed punched-out area of osteomyelitis in middle third of right tibia. Involvement extended some three inches along the bone.

This child reported to the clinic at intervals for a year and a half, during which time the low-grade infection persisted and several small sequestra were expelled. The infected area eventually healed—two years after the debridement and irradiation—but definite non-union existed in the tibia. A snug-fitting leg brace was then applied and the boy allowed to bear such weight as he could on the protected limb.

Six months later the patient was admitted to the Orthopaedic Hospital for operation. The first step was excision of the old scar and plastic skin closure. Healing was slow.

It was now over two and a half years after radiation and a bone-graft operation was done in apparently healthy tissue. The opposing ends of the tibia were split and a substantial piece of bone from the sound tibia was wedged into a prepared bed on the affected side. Some small bone chips were packed around the large graft, the wound closed, and a snug leg cast applied. Two weeks later the wound was a little moist at the old drainage site, and some straw-colored fluid exuded for the following two months. X-ray taken through plaster at this time did not show encouraging bone growth. The leg cast was changed three months after the operation and there was motion between the bone ends. A cast was reapplied, in which the patient was encouraged to bear weight. This policy was continued for the next three months when, on removal of cast, definite non-union was apparent. An x-ray showed general absorption of the graft at both ends, fracture in the center, and no tendency to bone growth across the defect in the tibia.

It was now over three years after irradiation, and about nine months after an unsuccessful bone-graft operation. The wound was healed, but the tissues were not very healthy. In the x-ray, that portion of bone nearest the surface in the old, diseased area appeared least viable, and both the soft tissue and bone had been traumatized by three surgical approaches and the irradiation.

Since it was necessary to do another bone-graft operation in the hope of getting union and a usable leg, it was decided to make a new approach where the tissues had not been repeatedly insulted, and to strike that surface of the tibia which had been farthest from the point of radiation.

A bed was prepared for another graft along the posterior aspect of the bone as far from the tibial crest as possible. A substantial graft was then taken from the sound tibia and securely fitted into this site. A number of bone chips were packed forward toward the most devitalized spot in the hiatus, and it was easy to close over the new bone work with good muscle tissue and very healthy skin.

Following this operation, a pin-point sinus opened and drained for a few days through the old scar but the new incision healed promptly. X-ray check of the progress

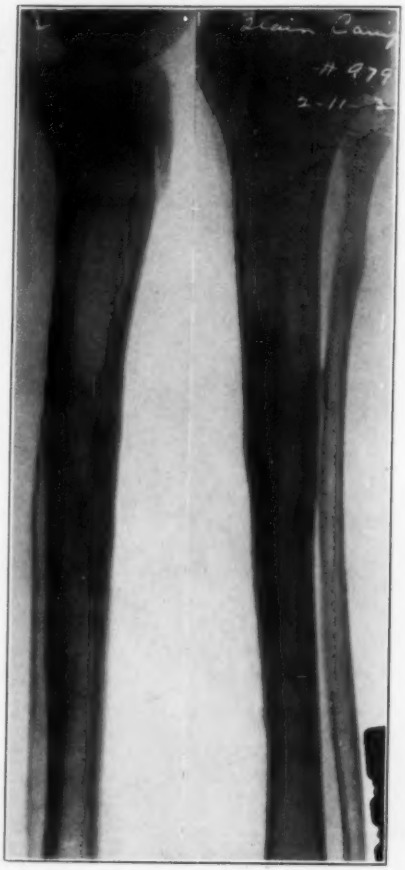

FIG. 7

Appearance of tibia three years after successful bone graft and nine years after first complaint of pain in the leg.

of this graft showed encouraging bone growth. The cast was changed three and a half months after operation and definite union was taking place. Protected weight-bearing was allowed two months later and apparatus was discarded fourteen months after operation. Further convalescence was uneventful.

This case is reported approximately ten years after the first symptoms, seven years after irradiation, and three and one-half years after the successful bone graft. There is less than one inch shortening of the involved limb; the boy has a good gait, and is in good health.

In Radiology, Desjardins[1] gives a résumé of experimental work reported in connection with growth injury to bone, following therapeutic irradiation, and reports a case. He states that in comparison with many other tissues, experimental investigation of the radio-sensitiveness of bone has been limited; that adult bone can tolerate relatively large doses of radiation, but rapidly growing osseous structures of young animals are influenced deleteriously even by small doses. He reported disturbance of growth in a child's arm, following irradiation of the humerus, and emphasized that great care should be exercised in the dosage of roentgen or radium rays, particularly if there is a question of the existence of malignancy in a given case. The high therapeutic value of x-rays and radium is in no way discounted.

COMMENT

The original lesion in the case reported here must have been a bone cyst, and the patient sustained a fracture of the tibia at this site. If the lesion was malignant it was evidently entirely cured by the radium treatment. There resulted, however, an irradiation osteitis, secondary infection in the tibia, and non-union.

At no time after admission of this patient to our clinic did the involved tissues have the appearance of any of the usual types of osteomyelitis. Drainage, when present, appeared to be coming from a source of tissue death, rather than from active infection. The x-ray appearance of the radiated tibia ends suggested poor viability. Following the first operation the bone ends, though not uniting, appeared more viable. The technique carried out in the first bone-graft operation should have been successful in the average case of non-union of the tibia.

The success of the second operation was due either to the fact that a certain necessary length of time had elapsed since irradiation and the bone affected had recovered viability, or the changed surgical approach found tissues more receptive. Both may have been factors. In the latter approach, the tissues had not been disturbed by former surgery and were on the opposite side of the bone from the applied radium. It is certainly safe to conclude that early after irradiation is not the ideal time to undertake plastic bone surgery.

1. Desjardins, A. U.: Osteogenic Tumor: Growth Injury of Bone and Muscular Atrophy Following Therapeutic Irradiation. Radiol., XIV, 296, Mar. 1930.

TENSILE STRENGTH AND ELASTICITY TESTS ON HUMAN FASCIA LATA*

BY CHAS. MURRAY GRATZ, M.D., NEW YORK, N.Y.

The possibility of more extensive use of living sutures in surgical fields has led to a study of the tensile strength and elasticity of the one most commonly used,—namely, fascia lata. This paper presents certain test data which have been selected from the observations made.

In 1924 a pioneer study in this field was presented by Gallie and Le Mesurier[1]. They made rough tests of the tensile strength of fascia taken from the backs of rabbits. The fascial strips were used to repair the edges of the gap left by their removal. These were recovered at intervals varying from a few days to two years and again tested. "No stretching or contracture occurs and the strength of the suture is approximately the same as at the time of operation." The above research, besides confirming the viability of fascia as suture material, also showed that its strength remained unimpaired over long periods. A search of the literature did not reveal any other tests of this nature.

In 1930 the author undertook to measure with engineering accuracy the tensile strength and elasticity of human fascia lata. To summarize the results briefly, the material showed surprisingly great tensile strength comparing favorably with soft steel wire of the same weight; in addition it showed an unexpected degree of elasticity. An effort was also made to utilize the test results clinically as an approximate guide in determining the correct size of suture to be used in operative procedures.

The test material was obtained from the thighs of patients who were at the time undergoing operations in which this material was to be used, a small piece of the fascia lata being reserved for test purposes. The test piece was immediately packed in saline-moistened gauze and sent to the testing laboratory. The elapsed time between the removal of the test piece and the actual testing of the material varied from two to eighteen hours. It is of interest to note that even after eighteen hours delay the material was essentially alive at the time of testing.

The tests were conducted by the New York Testing Laboratory on the standard tension machine used for the general testing of engineering materials, under the supervision of a consulting engineer, Mr. F. J. Nankivell. We hoped in this way to have the advantage of engineering experience and equipment to aid us in the solution of these problems.

*From the Department of Orthopaedic Surgery, New York Post-Graduate Medical School and Hospital.

The actual testing presented difficulties which had to be overcome before sufficiently accurate results were obtainable. The inherent difficulties were that the fascia was of a soft and slippery nature and that only a small test piece was obtainable. It was necessary to line the grips of the testing machine with emery cloth to prevent slipping, and also to pierce the fascia lata with small pins to obtain points which could be used for measuring the amount of stretch or elongation. Due care had to be exercised to apply steady tension in order to avoid fluctuations which would have resulted in excessive inaccuracies.

The following reproduction of one of the test sheets on fascia lata taken from an athletic individual is self-explanatory.

TENSILE TESTS ON SUTURE FROM LEG OF MAN

Weight in grams	1.305	Average thickness	0.014in.
Length	4.7 in.	Average area	0.0084 sq. in.
Width	0.60 in.	Dis. bet. heads no load	1.73 in.

Test No. 1		Test No. 2		Test No. 3	
Load lbs.	*Elongation reading in.*	*Load lbs.*	*Elongation reading in.*	*Load lbs.*	*Elongation reading in.*
0	1.30	0	1.30	0	1.325
5	1.31	4	1.33	7	1.34
8	1.32	8	1.34	12	1.35
12	1.34	12	1.34	16	1.36
16	1.34	16	1.35	20	1.365
20	1.34	20	1.36	25	1.37
24	1.365	24½	1.365	30	1.37
		30	1.37	36½	1.38
		36	1.38	40	1.385
		40	1.39	48	1.40
		44	1.40	52	1.40
		48	1.405	56	1.405
				62	1.405
				66	Broke
Remove load		*Remove load*			
20	1.36	40	1.39		
16	1.35	36	1.383		
12	1.34	30	1.380	Tensile	
8	1.33	23	1.37	strength lbs.	
5	1.32	16	1.36	per sq. in.,	7,860
0	1.30	10	1.355		
		5	1.35		
		0	1.325		

Remarks: Pins inserted into suture for gage marks. Emery cloth used in grips. Good break was obtained between grips. Failure was of the nature of a slippage of fibers.

Operation performed 3:00 P.M., October 6. Kept wet with saline solution. Test at 10.00 A.M., October 7.

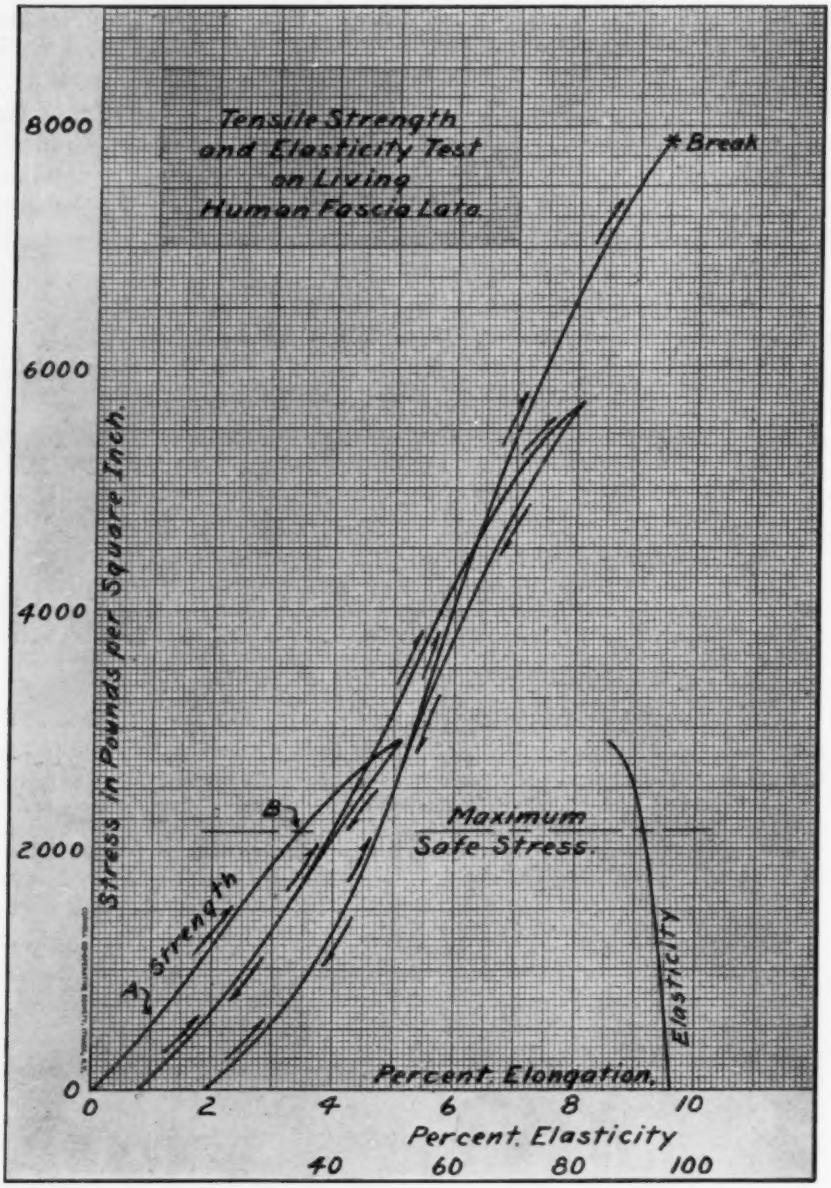

CHART I

The portion from *A* to *B* on the strength curve has been selected from an engineering standpoint as the safe working range, as it is the portion where the material shows its greatest elasticity. It will be noted that the elasticity curve within this range shows that the elasticity is well above ninety-one per cent. Above the line of maximum safe stress the strength curve bends sharply and the elasticity curve shows the same phenomenon. The position of the curve above this line shows these tests carried on to destruction. While it is of interest to know the percentage of overload which this tissue may stand, the operative technique should be so devised as to limit the stress to a point within the range indicated.
(A physiological explanation of the above phenomena is presented in the text.)

After making the necessary engineering allowances for inaccuracies in instrument readings we were able to prepare a composite of the results of data on material from several individuals, and from these to plot the accompanying graphs of tensile strength and elasticity (Chart I).

The curves in these graphs show the reaction of fascia lata to varying degrees of tension; the graph on the right shows the corresponding elasticity. As tension is applied an elongation takes place, at first quite pronounced (*O* to *A*). The material then stiffens (*A* to *B*) and finally relaxes again. Upon releasing the tension the test piece returns nearly to its original length. When subjected to tension greater than before, the same cycle is repeated except that the material is slightly stiffer and less elastic. When sufficient tension is applied the material is destroyed and a calculation of the maximum tensile strength is obtained.

It is of interest to study the above findings in relation to the structure of fascia lata as shown by microscopic study. This tissue consists of "a mass of very thick parallel fibers which runs a straight or slightly wavy course. Between these fibers are scattered a small number of connective-tissue corpuscles (tendon cells). The fibers are gathered into bundles which are separated by a small amount of areolar tissue. The parallel arrangement of heavy fiber fascia and tendon gives these tissues great strength in one direction,—that is, in the direction in which they are normally subjected to strain."[2]

A probable explanation of the phenomena observed rests in successive adjustments of the material composing fascia lata to the tension applied. The areolar tissue cells, being weaker than the fibers, are the first to break down, leaving the tension to be resisted by the stronger fibrous material. With an increase in the tension applied, the fibers begin to separate from the tendon cells. The final rupture of the material occurs with the pulling apart of the fibers one from the other. Macroscopically the fibers themselves did not appear to break. In the three materials the cohesive forces within the areolar tissue are comparatively weak. The adhesive forces between tendon cells and fibers are greater and the cohesion in the fibers themselves shows the greatest strength.

The fibers are also the elastic elements. The elasticity is interfered with to some extent by the areolar tissue, especially after it is broken down by excessive stretching. In spite of this, however, the elasticity (the capacity to return to original dimensions) of the material, under the limits of maximum safe stress, is above ninety-one per cent., as shown by the elasticity curve. The graphs in Chart II depict the result of a similar test of prepared fascia lata and demonstrate the variations in strength and elasticity between the living and dead tissues. It will be noted that the elasticity of the latter does not compare favorably with the living fascia lata, hence its maximum safe stress would be much less. The comparative strength and thickness of human fascia lata from three individuals as shown below indicates that there is a comparatively small variation in maximum strength.

	Average thickness	*Maximum tensile strength*
Adult female seventy-four years of age	.017	6222
Athletic male thirty-five years of age	.014	7860
Paralytic female fifteen years of age (both legs involved for ten years)	.030	6375

From an analysis of the above data, the following observations may be made:

Maximum load for living fascia lata sutures.

The strength of fascia lata is proportional to its area of cross section. Thickness in the specimens studied varied from one-sixty-fourth to one-thirty-second of an inch. Taking an average thickness, the breaking tension of a strip of this material three-eighths of an inch wide is about fifty-five pounds. Working under the maximum safe stress, as described in the graph, the optimum load applied to such a strip should not exceed fifteen pounds.

When it is thought that the load requirement may be in excess of the above figure, a larger or multiple suture should be used. When a suture is tied in a loop, it is approximately equivalent to a single suture of double strength provided that the technique of tying is correct. Multiple sutures are preferable to wider ones as a proper lymph supply more readily reaches the central portion. The following table is an approximate guide for the widths of sutures for clinical use, based on average thickness of .02 inches (one-fiftieth of an inch):

Width in inches	*Safe tension in pounds*	*Width in inches*	*Safe tension in pounds*
3/16	8.07	3/8	16.1
1/4	10.75	7/16	18.8
5/16	13.5	1/2	21.5

Comparative strength of fascia lata.

The specific gravity of fascia lata is about 1.31 and the average ultimate tensile strength is approximately 7,000 pounds per square inch. Soft steel has a specific gravity of 7.83 and an ultimate strength of about 45,000 pounds per square inch. Thus fascia lata is nearly as strong as soft steel, weight for weight.

Elasticity of fascia lata.

The high elastic property of this tissue is important since it tends to correct any displacement of osseous structures after operation, if the sutures are properly placed. The presence of excessive fatty tissue may interfere with their elasticity and also their viability.

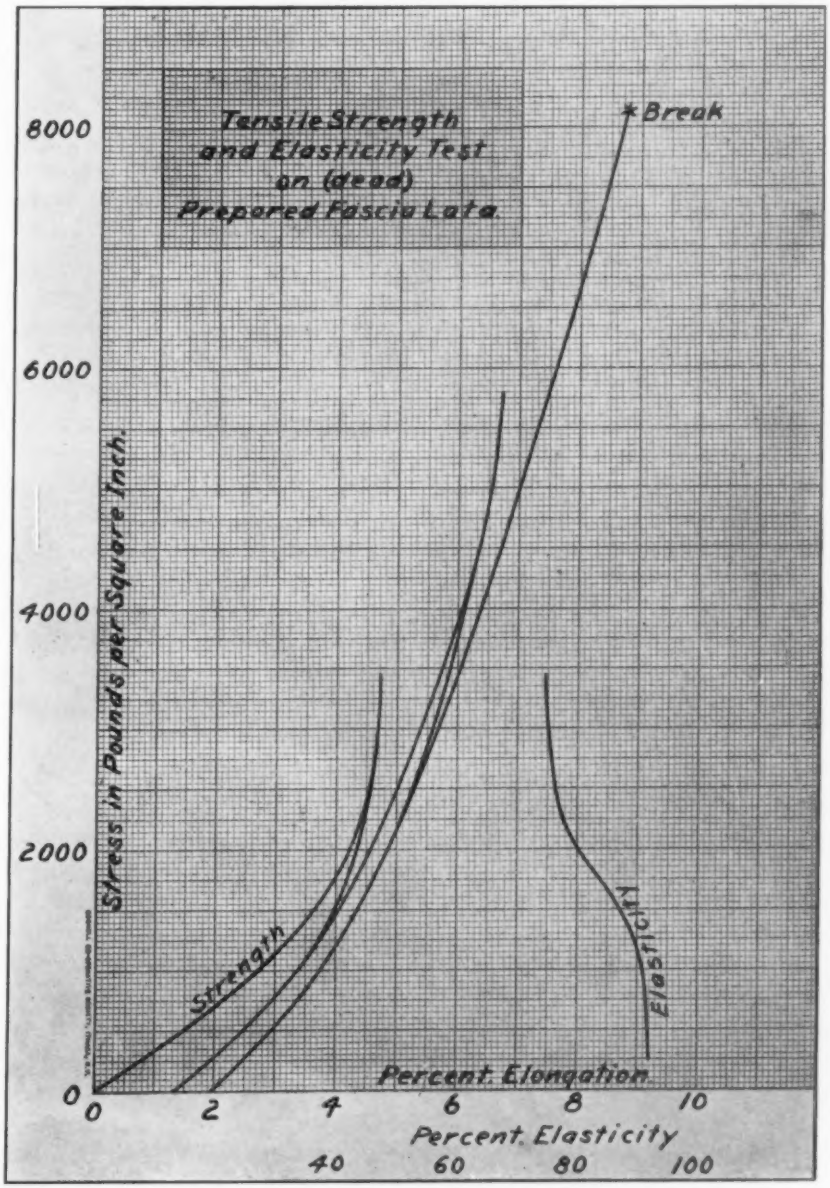

CHART II

COMMENT

The above observations presuppose that the sutures are used in such a way that the stress is placed longitudinally in the direction of the fibers, since fascia lata has very little strength in the transverse direction. Operative procedures must be so devised as to bear this in mind. It is hoped that these tests and observations may supplement previous researches and be of value in the clinical use of living suture material. Similar tests of other fascial tissues are contemplated.

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1. Gallie, W. E., and LeMesurier, A. B.: The Transplantation of the Fibrous Tissues in the Repair of Anatomical Defects. British J. Surg., XII, 289, 1924–1925.
2. ——— The Use of Living Sutures in Operative Surgery. Canadian Med. Assn. J., XI. 504. 1921.

THE MINUTER ANATOMY OF ATTRITION LESIONS

BY A. W. MEYER, M.D., STANFORD UNIVERSITY, CALIFORNIA

Department of Anatomy, Stanford University

Unless it can be assumed that the articulations of man are frictionless, the old teaching that articular cartilages are not subject to wear, and also that they do not regenerate, necessarily is self-contradictory. Since the curvatures of the apposed cartilages are not exactly congruous and since cartilage is compressible, it follows that the areas in movable contact constantly vary in size and position during movement. Although these areas increase in size under pressure, this pressure per unit area must, nevertheless, be considerable even in some of the larger joints of the body under the load of body weight alone, and must be greatly increased under burden-bearing or other exertion.

It has long been known that the surfaces of articular cartilages are not perfectly smooth, and although this slight roughening is an aid to lubrication, the existence of these inequalities on the surface probably increases friction. The surface appearance of adult hyaline articular cartilage bears abundant evidence that friction is not wholly absent in wholly normal joints and the appearance of the articular discs speaks to the same effect.

Since synovia is not a pure liquid, but contains solids in the form of particles from both cartilage and capsule, friction also must be increased on this account. Although most of these fragments of cartilage contained in synovial fluid are microscopic in size, many of them can be seen easily upon inspection of the larger joints with the unaided eye, and others are large. I am not concerned at present with the latter, commonly spoken of as joint mice (free bodies or corpora oryzoidea) which, it is held, are detached by sudden trauma, although, in a sense, all free cartilaginous bodies, no matter how small, which are contained in joints must of necessity be traumatic in origin, unless detached by disease. Although the fragments spoken of as joint mice are supposed to result from the sudden application of considerable force, this explanation cannot account for the smaller free cartilaginous constituents of synovia, which are here considered. They result from daily use of normal joints and hence are traumatic only in this restricted sense. They usually are thin, but may be several square centimeters in area.

Upon the free surfaces of articular cartilages in any of the larger joints from individuals past middle life, as seen in the dissecting room, one usually can see fine, hairy or scale-like appendages such as are represented in Figures 1, 2, 3, and 4. These filamentous appendages which lie upon the smooth surface of the cartilage or project vertically from it, not infrequently are so numerous as to give the cartilages a hairy or fuzzy appearance when raised from the viscous surface by gentle stroking. It also is not rare to

FIG. 1

Small filaments on the articular cartilage on the tubercle of the left temporal bone.

FIG. 2

Small filaments on the right patella.

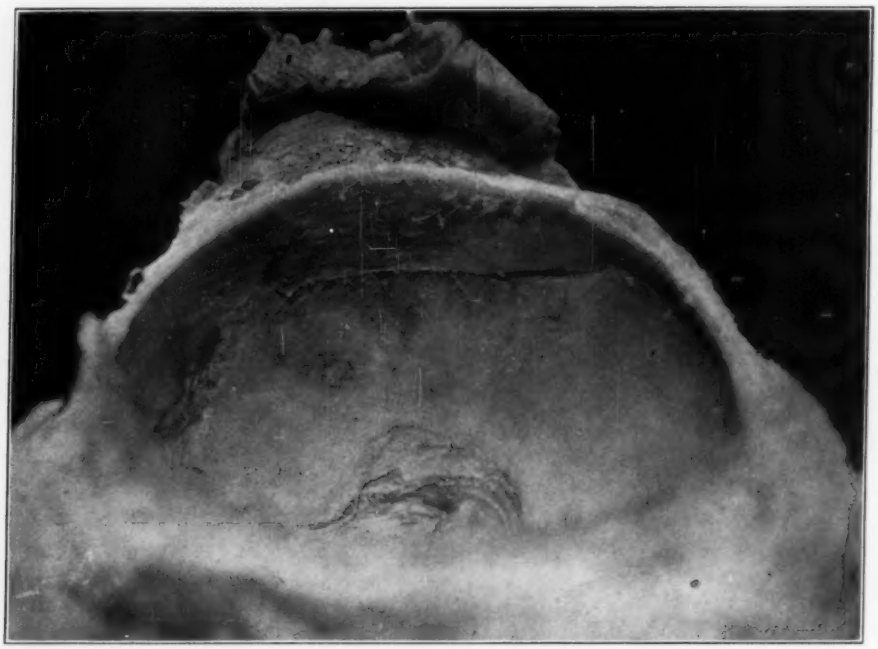

FIG. 3

Small filaments on the superior portion of the cartilaginous acetabular margin.

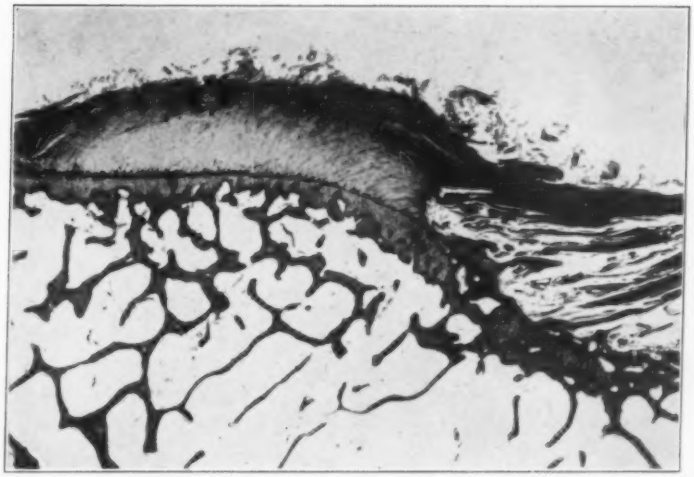

FIG. 4

Small filaments on the inner wall of the subdeltoid bursa in the region of the greater tuberosity of the left humerus, in microscopic section.

find small filaments or thin scales, lying free or partly attached, upon the cartilages or upon the internal surfaces of the articular capsules. The gross or microscopic appearance of these attached or detached filaments or scales does not suggest, as a rule, that they are fragments of the hyaline articular cartilages. Grossly most of them appear to be truly fibrous, but they really are found to be only fibroid upon microscopic examination, and represent partially or wholly detached fragments of the thin superficial layer of the hyaline articular cartilages or detached portions of the intra-articular discs or of the capsules. In the last case they are truly fibrous, to be sure. The scale-like or membranous appearance of the larger portions, such as are represented in Figure 5, is due to the fact that they are portions of the thin superficial layer of the hyaline cartilage, the presence of which has received but little consideration since the days of earlier anatomists, and the existence of which usually is ignored in textbooks on histology and gross anatomy.

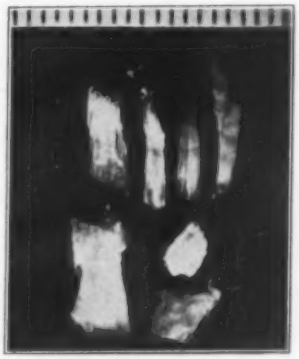

FIG. 5

Free scale-like fragments of cartilage commonly found in normal joints.

If one attempts to remove these partly detached scales and filaments, one not infrequently obtains a narrow though long thin strip which may be almost or just as long as the cartilage happens to be wide, and which always is continuous with the so called synovial membrane at the periphery. Those conversant with the history of the development of our idea of the structure of articular cartilages and syno-

FIG. 6

Largely detached flaps of the superficial membranoid layer of hyaline articular cartilage on the heads of two right femora. The first flap lies near the periphery of the head and the other near the capitular fossa.

FIG. 7

FIG. 8

Similar flaps and strands of the thin surface layer of hyaline cartilage from the distal extremities of the proximal phalanx on the right second finger.

vial membranes, will recall that great anatomists of the past (See Sigurdson, *Journal of Bone and Joint Surgery*, XII, 603, July 1930), including the brilliant Bichat, held that the free surfaces of hyaline articular cartilages were, in fact, covered by a synovial membrane, and others than contemporary medical students have been similarly misled. It is quite surprising how large a portion of this thin superficial fibroid layer of hyaline articular cartilage may be removed with a forceps, especially from the patella, the condyles of the femur, or from the cartilage on other large, long bones.

It is especially interesting that relatively large membranous flaps of the thin superficial layer,—such as those represented in Figures 6, 7, and 8—not infrequently are found largely detached in otherwise wholly normal joints. Although both of the large thin flaps shown in Figures 6 and 7 were found on the heads of femora, similar though smaller flaps are frequently seen in other articulations, as shown in Figure 8. As indicated in the above figures, these detached flaps of the superficial fibroid layer of hyaline cartilages are directly continuous with the so called synovial membrane covering the round ligaments, the capitular and acetabular fossae, and the neck of the femur, and it is not difficult to see how such appearances as these probably misled the older anatomists and why they continue to mislead students and others. But since it is impossible to detach a similar layer from the interior of the capsules, one may wonder why we still say that they are lined by a distinct layer designated as synovial membrane. I am, to be sure, not maintaining that articular cartilages are covered by a synovial membrane, but that there really are only synovial surfaces and not membranes.*

*This question is dealt with more fully by Sigurdson.

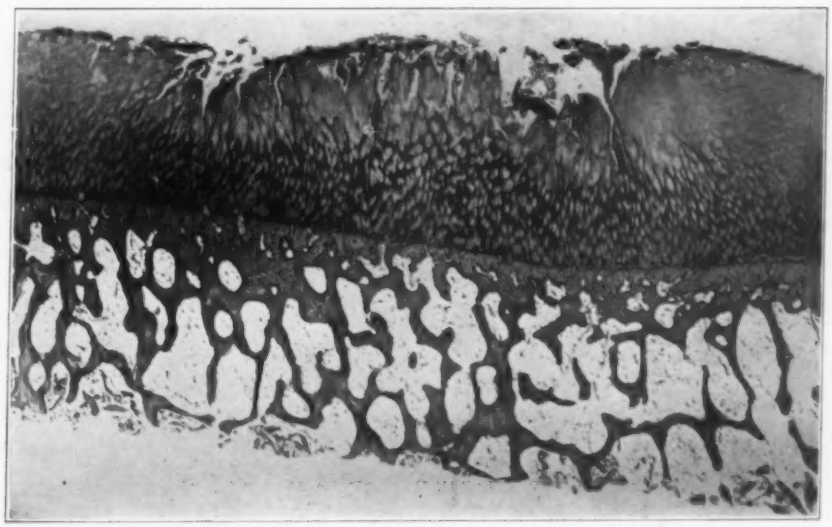

FIG. 9

Peculiar change in the deeper portion of the intercellular substance or matrix of hyaline articular cartilage from a right patella suggesting an irregular extension upward of the process of calcification.

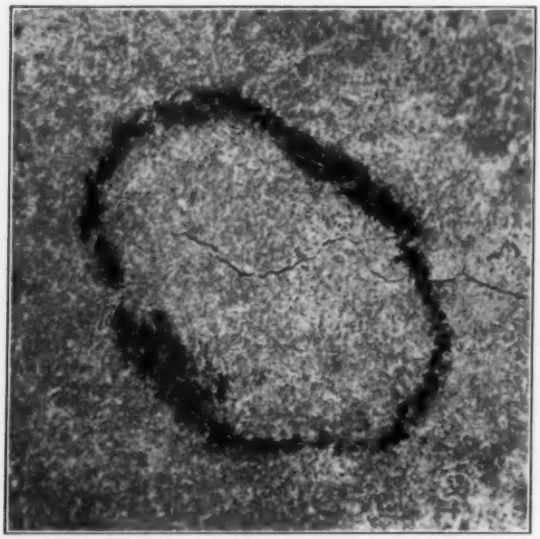

FIG. 10

A vascular sulcus in the compacta on the head of the humerus.

Anyone who has attempted it has found that it is impossible to detach a second thin membranoid flap from an area of hyaline articular cartilage from which one layer has already been stripped, or from an area in which the cartilage shows grosser effects of wear. Upon the latter areas this layer no longer is continuous and it may be absent altogether. Whether or not hyaline articular cartilages continue to retain a thin superficial layer which can be stripped from them if they are thinned very slowly by wear, probably depends upon the rate rather than upon the amount of wear to which the particular cartilage is subjected. Although this detachable superficial layer with degenerate nuclei arranged parallel to the surface is very thin, there is some reason to believe that a substitute is formed below it, provided the rate of wear is not too rapid, for not infrequently the condyles of the mandible in advanced life are covered only by such a thin layer of fibrocartilage containing degenerate nuclei. This layer must, to be sure, be a remnant of the former thicker layer of cartilage, and although it has been suggested that the underlying portions of the original cartilage were in these cases converted into compacta, I have so far been unable to obtain any good evidence of the occurrence of such a transformation. Practically nothing but such a thin fibroid layer is found covering the mandibular condyles from the aged, in whom absorption of bone is marked, and the compactae upon these condyles are not thickened as they should be if the articular cartilage on the condyles had largely been converted into bone. I realize, to be sure, that this would not hold if the spongiosa extended upward as ossification advanced into the articular cartilages during this process, but this would imply an increase in length of this and other bones. It would also result in bony contacts and erosion and polishing even if the ossification of the hyaline articular cartilages proceeded at a uniform rate throughout the entire extent of the cartilages. Although I have found evidences of ossification of articular cartilages, the process always was local, not limited in depth, and was responsible for the production of terraces on the apposed, polished bony surfaces. This ossification is associated with injury to the cartilage.

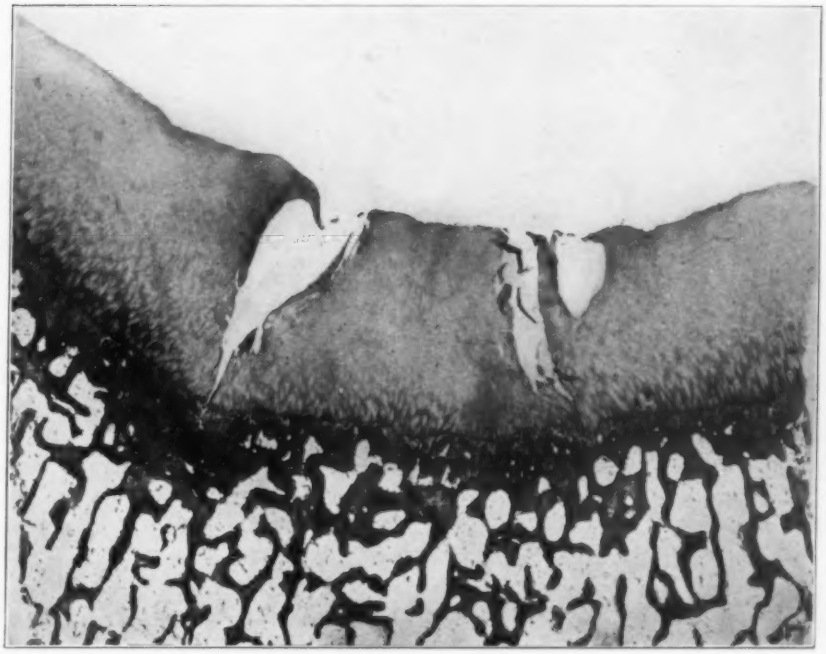

FIG. 11

A section from the intercondylar region of a left femur showing fissuring of the hyaline articular cartilage and of the underlying compacta.

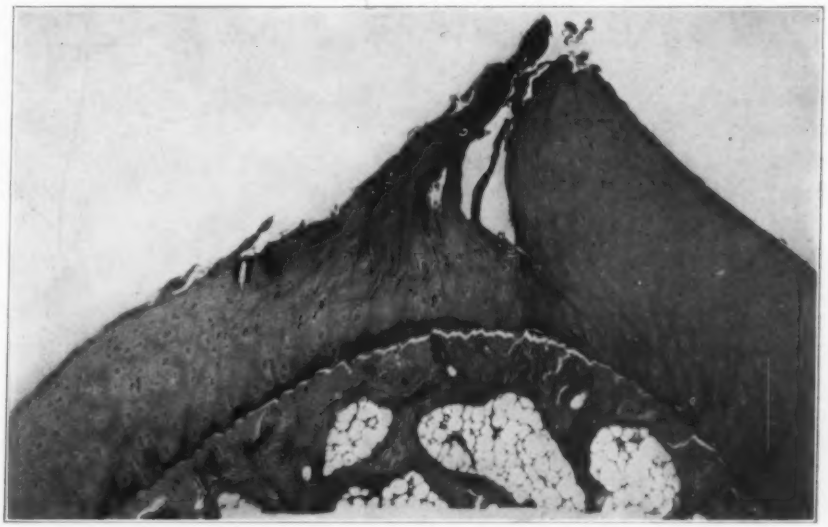

FIG. 12

A photograph of a celloidin section of the articular cartilage and the underlying bone from a right capitate, showing injury from wear in the form of small isolated degenerate fragments of cartilage and of fissuring and detachment of the latter.

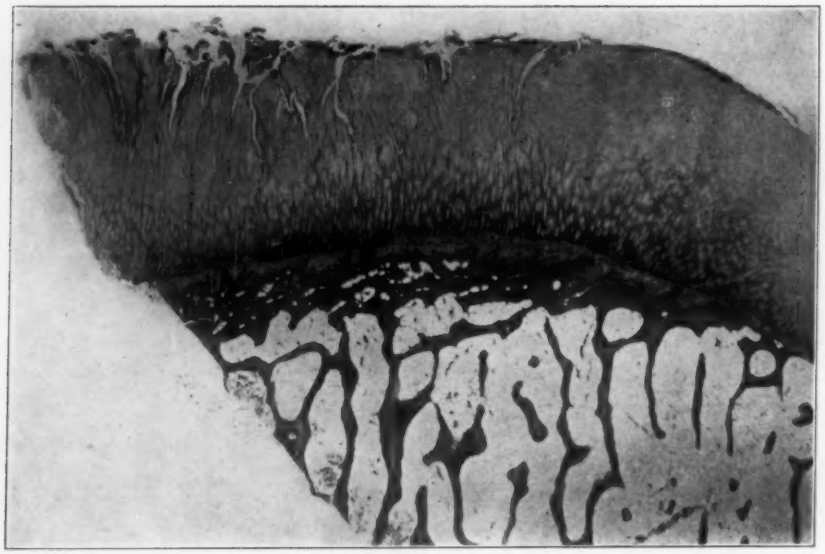

FIG. 13

A section from the portion of the articular cartilage of the lateral condyle of the left tibia from the region covered completely by the meniscus.

I previously called attention to the fact that the furriness so commonly seen on the articular cartilages, especially on those of the patella, may be purely superficial and that it may be marked in what appear to be entirely normal joints. I also found that the articular cartilages may be entirely denuded on bones which bear no gross evidences of disease and I now find that the same thing may happen in bones which show no histologic evidence of disease. The evidence for this conclusion was obtained by removing from bones associated with grossly normal joints, a series of specimens of articular cartilages with some underlying bone, which showed fraying or other evidences of wear, for microscopic study after preparation by celloidin technique. The joints were first examined by the unaided eye and the cartilages described and photographed in order that the gross and microscopic findings could be correlated.

Upon inspection of joints in the dissecting room, it is not unusual to find portions of the hyaline cartilages which have been partly loosened from the underlying compactae. Inspection in many such instances with the unaided eye or under low magnification with a hand lens failed to reveal any evidences of the presence of pathological conditions which might have been responsible for this detachment of the cartilages. Inspection of the entire joints likewise revealed no disease and microscopic examination showed both bone and cartilage to be normal.

Upon the basis of evidence present in the dissecting room, it seems highly probable that the effect of motion, in normal use, may slightly detach processes of hyaline or articular cartilages of considerable size, and that the

presence of joint mice, hence, need not be due to the application of sudden force or result from disease. The gliding of one cartilage upon another can subject a relatively small area on the one, such as the superior portion of the acetabulum, to great pressure and wear, while a relatively large area on the other—the femoral head—passes back and forth under body weight alone or with a load in addition. Under the influence of such pressures it is not surprising that considerable portions of the acetabular hyaline cartilage in this region frequently become loosened from the underlying bone and finally are detached altogether in larger or smaller plaques. Such an occurrence is all the more likely where the apposed articular surfaces are less congruent, as in case of the patella and the condyles of the femur. However, partly detached articular cartilages also are frequently present on some of the carpals such as the pisiform, triquetrum, hamate, and lunate.

Since the hyaline articular cartilages on the apposed ends of the bones of the extremities frequently show three zones different in structure and hence probably also in strength, one should, *a priori*, have concluded that cleavage could and probably would occur where these zones met, for each zone would yield differently under friction and stresses accompanying motion. Moreover, since the hyaline articular cartilages are fastened to the underlying compactae, a third line of possible cleavage exists at the extremities of all long bones provided they possess a thin superficial

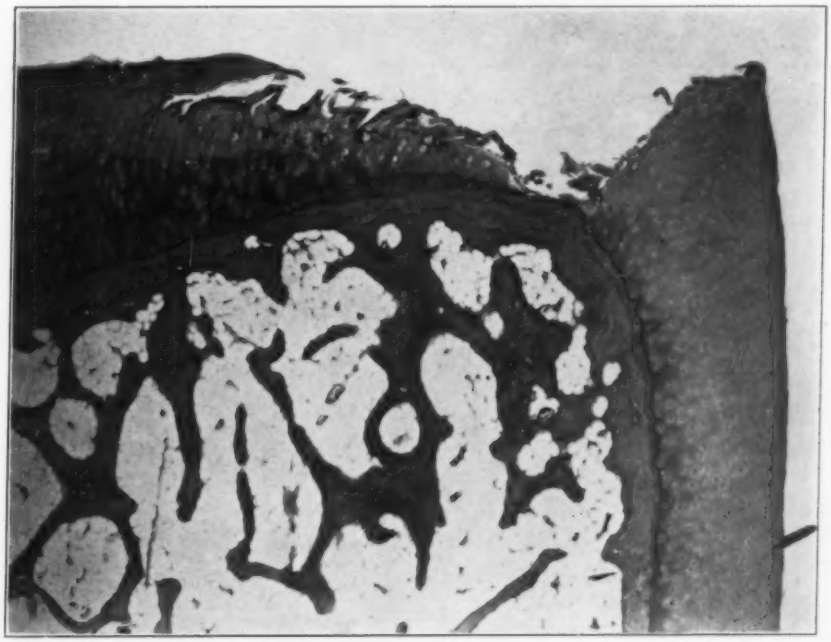

FIG. 14

Section from the articular cartilage including the underlying bone, in cases of wear: the right hamate.

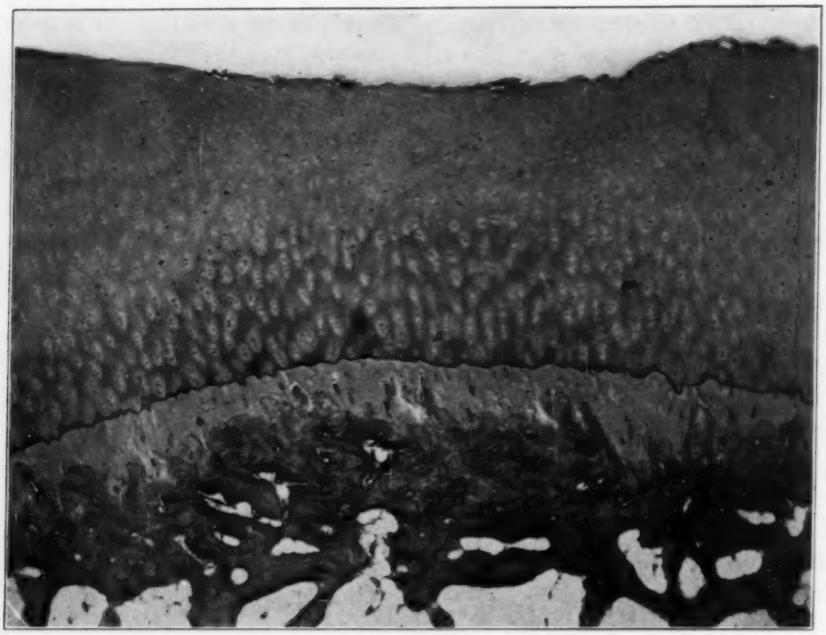

FIG. 15

Section from the articular cartilage including the underlying bone, in cases of wear, from the same body: the associated right lunate.

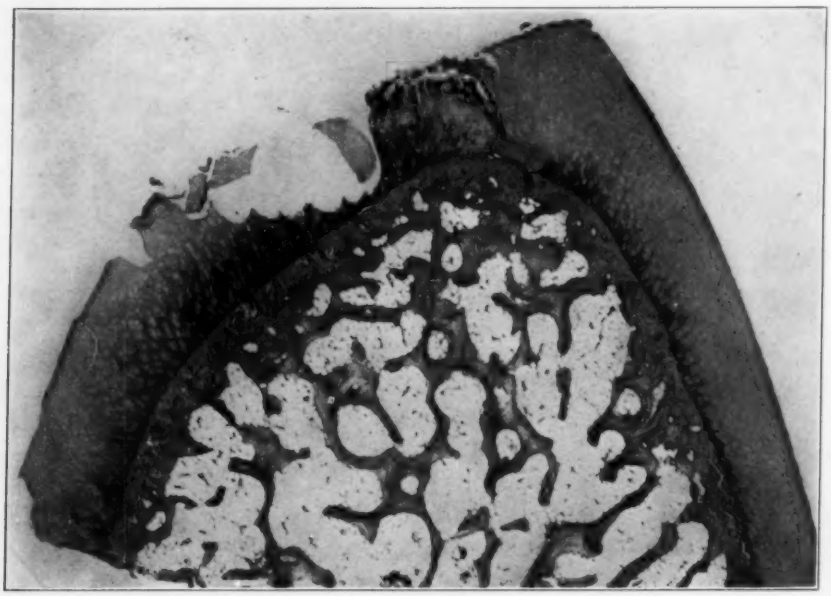

FIG. 16

Section from the articular cartilage including the underlying bone, in cases of wear, from the same body: the left hamate.

fibroid, a deeper calcified cartilaginous zone, and an intermediate zone of uncalcified hyaline cartilage of the usual structure.

The first line of possible cleavage apparently would lie between the thin superficial fibroid and the intermediate typical layer of uncalcified hyaline articular cartilage; the second between this thick middle layer and the deeper and thinner calcified zone; and the third line of cleavage between the latter and the underlying compacta. Not infrequently a second "*Trennungs Linie*" is present in the cartilages, but I know very little about the incidence of this as yet. However, the presence of such a second line would seem to imply a fourth plane of possible cleavage and separation. Since these different strata of the articular cartilages on the long bones of the extremities must yield differently to deforming forces, it is easy to see where separation might occur, and it is satisfying that microscopic examination confirmed the presence of local cleavage between all these areas of contact except between the two incomplete layers of the calcified zone, of which only a few instances have so far been seen.

In regions of cleavage between the superficial, membranoid, and the underlying characteristic hyaline layer, and between the latter and the calcified zone, I have never found any sign of cellular reaction, suggesting the presence of reparative processes, although such processes were observed in the bone between the calcified zone and the underlying compacta. It is not rare to find very small degenerate detached fragments of cartilage

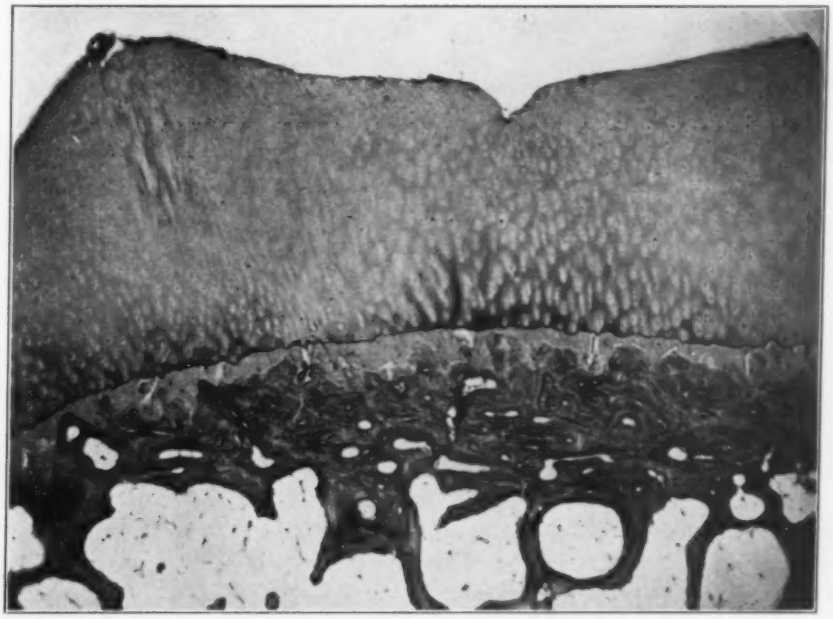

FIG. 17

Section from the articular cartilage including the underlying bone, in cases of wear, from the same body: the left lunate of the same wrist. Note the entire absence of inflammatory reactions.

FIG. 18

Capsular fringes on the anterior superior portion of the capsule of the right hip joint.

in these places accompanied by the outgrowth of vascular connective tissue from the marrow through apertures in the compacta.

When I first noticed that the compactae at the articular surfaces of apparently wholly normal, long, adult bones not infrequently contained perforations, and that capillary loops and tongues of marrow extended out into the overlying layer of calcified cartilage, I thought that obliteration of these terminal foramina by gradual extension of ossification in the course of time, might lead to a weakening of the articular cartilage through interference with a source of nutriment, and thus facilitate its destruction; but this does not seem to be the case. However, there can be little doubt that these excursions of blood vessels and marrow, some of which may be present even in advanced life, must help to nourish the overlying cartilages, and hence must be instrumental in maintaining their integrity and strength. However, cartilages which contain incursions of marrow may show evidence of wear, and this applies also to cartilages in which the intercellular areas show a peculiar change, probably calcification, such as is evident in Figure 9. I do not know positively what this change is, but there seems to be no relation between it and the occurrence of surface injury from attrition of the cartilage, although increasing calcification must affect the strength of the cartilage.

I was also surprised to encounter unmistakable vascular channels, such as represented in Figure 10, in the compacta upon the articular ends of some bones, and it is possible that their presence may also have a bearing upon the intimacy of attachment of articular cartilages.

As indicated by gross appearances only, the thin superficial fibroid layer found on normal hyaline articular cartilage may be destroyed locally, or the cartilage may be fissured deeply. In some cases even the underlying compacta shows evidence of injury, as shown in Figure 11. In one of these instances the spongiosa extending into the cartilage contains a large medullary space largely filled with fat. This lies wholly in the zone of calcified cartilage, and is covered only by a highly cellular cartilage and the thin superficial grossly membranoid layer. The cells of the spongiosa near the cartilage contain almost nothing but fibrous tissue, and some of the unossified cartilage is surrounded by the bony outgrowths.

Not infrequently portions of cartilage containing nests of nuclei or even badly preserved cells are found lying loose upon the worn surfaces. If the fissuring in the cartilage is superficial and numerous, a portion of the cartilage looks furred with the tufts of worn cartilage directed approximately vertically to the articular surface, as shown in Figure 12. Not infrequently these tufts are quite degenerate at their free ends, and stain as intensely with eosin as the small detached fragments occasionally found between the cartilage and the underlying compacta where the latter has become loosened.

It was surprising to find that fissuring and furring of hyaline articular cartilage occurs also on the tibial condyles in the region beneath the

FIG. 19

Capsular fringes on the inner surface of the left humeroscapular capsule dorsal to the intertubercular sulcus.

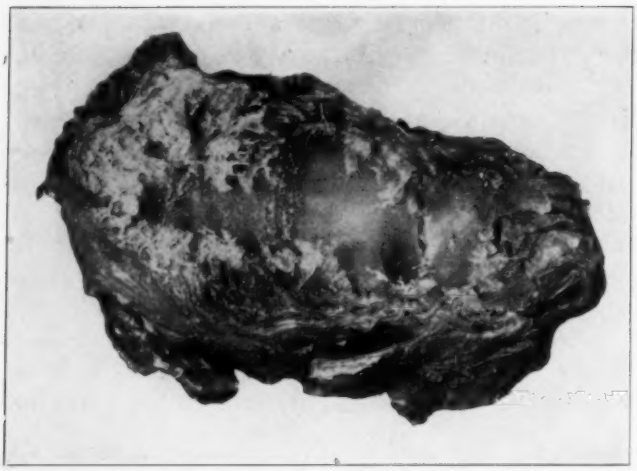

FIG. 20

Capsular fringes in the right radiocarpal articulation.

menisci. Figure 13 is taken from a celloidin section from a specimen taken from this area of a lateral condyle. Although the fissuring extends fully half way into the depth of the cartilage, and although some fine cartilaginous debris is found on the surface, the cartilage still is firmly attached to the underlying compacta and the spongiosa shows no evidence of the presence of disease.

Although the defects in the coapted cartilages on the hamate and lunate often are deep, as shown in Figures 14, 15, 16, and 17, no microscopic detached fragments were found in the articular cavities. The larger detached fragments evidently had been digested after being reduced by motion, and the products of digestion absorbed. Had this not been the case, the composition of the synovial fluid would, of course, have been changed, and a precipitate would probably have been present in the cavity.

It is especially interesting and significant that the apposed cartilaginous articular surfaces frequently show exactly corresponding lesions on both sides of the same body, and that all stages in the process of denudation and polishing of the underlying compacta frequently are illustrated on carpals which otherwise appear wholly normal, as do the capsules and ligaments of the articulations concerned. Excellent evidence to the same effect is also offered by the unequal intensity of these lesions in the articular cartilages in a pair of upper extremities, one of which suffered amputation below the elbow. The evidences of wear always are much intenser in all articulations of the remaining arm than in the amputated one, and while it is possible that the unaffected arm would be more likely to suffer from arthritis because of the greater use to which it is put, I feel confident that such an explanation does not account for the facts observed. It also is significant that no evidences of local or general cellular infiltration or destruction were found in any of the specimens, and that invasion of the calcified cartilage by extensions of bone from the underlying compacta were seen in only two instances.

The cartilages on the head of the radius, capitellum, and patella are the ones which most commonly show these surface or deeper defects, and

this is exactly what one should expect, if use is an important even if not always the sole factor in their production. A portion of each of these surfaces is subjected to severe strain during movements executed under a load, the radius often being subjected to rotation about a longitudinal as well as about a transverse axis, and the patella not infrequently moving sidewise as it glides on the femoral condyles. Moreover, both these bones, as well as those with which they are in contact, are frequently subjected to shocks of considerable severity. The articular cartilages on both bones show injury most frequently in the areas in most frequent contact, which are subjected to greatest use.

Since hyaline articular cartilage is non-vascular, one cannot claim that the resistance to infection of the cartilage in the affected areas has been lowered, and hence conclude that infection is localized particularly here and produces the lesions. I have never encountered evidence that infectious processes reached the surface of the cartilages from the underlying marrow or from the periphery in these cases. Furthermore, evidences of the existence of arthritides are wanting in most of the joints in which these changes are found in the cartilages. Hence, it seems to me that it is unlikely that infectious processes need be considered as a primary cause for these changes, and the same thing holds for the presence of intracapsular fringes composed

FIG. 21

Capsular fringes in the right knee joint.

FIG. 22

Proximal extremity of the left fibula bearing the detached tibial articular fibrocartilage.

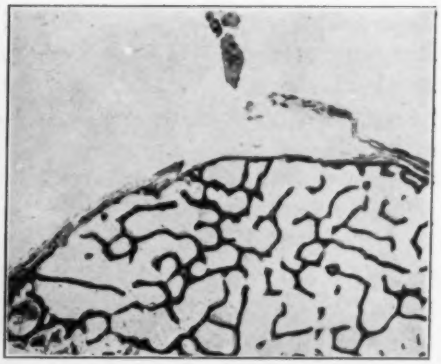

FIG. 23

A photograph of a celloidin section of a portion of the fibular facet of the tibia from which the cartilage shown in Fig. 22 had been detached.

of processes or tags which commonly are included among synovial villi, such as represented in Figures 18, 19, 20, and 21. Figure 19 shows a considerable patch on the inner surface of the humeroscapular articular capsule in a region lateral to the intertubercular sulcus. This figure also shows fine fringes on the periphery of the articular cartilage. In Figure 20 similar capsular fringes extend around the entire perimeter in the radiocarpal articulation, and defects also are present in two places in the ulnar articular disc. Defects also are present in the articular cartilage of the radius. A capsular fringe is shown particularly well in Figure 21, in an anterior view of the knee joint, and similar fringes also are found in the region of the acetabular imprint on the neck of the femur. Such fringes as these frequently are composed of slender, flat, firm projections attached to the inner surface of the articular capsules. They vary up to one-half centimeter in length, and usually have tapering extremities. They occur most frequently

FIG. 24

A section of the detached cartilage showing an entirely normal structure.

in the region of contact between the capsule and the periphery of the articular cartilages. Their microscopic structure does not suggest that they represent capsular outgrowths, although some of them have bulbous ends. The surfaces of most of them are not smooth and shiny, as one would expect synovial surfaces to be; and I feel quite convinced that most of these fringes also are attrition products. I have not infrequently encountered bulbous ends on the strands of partly or wholly divided bicipital tendons, and the presence of such ends does not seem to have any special significance in the differentiation between what might be regarded as true or false synovial villi, especially not since bulbous ends may be due to the presence of fat.

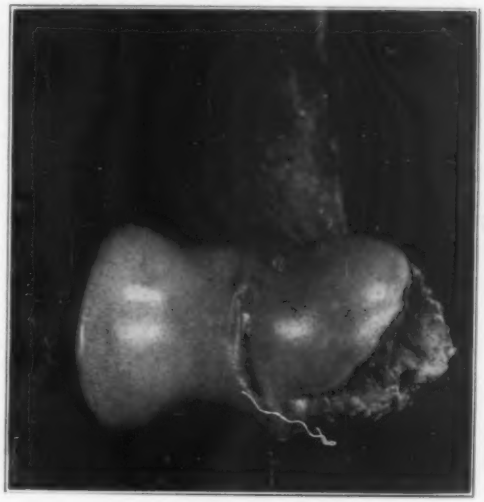

FIG. 25

Attrition defect commonly seen on the cartilaginous articular ridge on the distal extremity of a left humerus. Defects here are extremely common after the third decade of life in the cadavera of all working people.

If one assumes, as is frequently done, that such fringes as these, and those on the inner surfaces of articular capsules and on the interior walls of bursae, are due to inflammatory processes, then one also must assume the

FIG. 26

A circular attrition defect in a left ulnar articular disc with wear on the fibro-articular cartilage on the distal extremity of the ulna. In its earlest stages the defect in the articular disc is always a dorsoventral slit.

FIG. 27

A somewhat deeper attrition defect in the center of the head of a left humerus.

occurrence of an almost universally present inflammation of these structures after the second decade of life. Moreover, if the fissures, fringes, and tufts on hyaline and fibro-articular cartilages also are due to disease, then it would seem to follow that variations in the normal form of an articular surface can determine the presence of inflammation. Whenever the hamate and lunate articulate by two instead of by a single surface, the cartilages on the smaller narrow surfaces of these carpals almost always show wear in older persons, and portions of the denuded underlying osseous surfaces not infrequently are polished. Whenever these bones articulate by means of a single surface, on the other hand, gross evidences of wear are slight or absent altogether. Moreover, these phenomena usually are bilateral and those who insist that the erosions of cartilage which I have attributed to normal use are in fact due to infection, must explain how a slight anatomical variation in the form of two coapted articular surfaces always leads to bilateral inflammation, and why the effects of the latter are confined strictly to these surfaces which often are only a few millimeters wide. Since injury to the articular cartilage on the distal extremity of the humerus often is confined to the intra-articular ridge which forms the boundary between the capitellum and the trochlea, the same reasoning also can be applied here.

It is not uncommon to find pedunculated masses of fat up to several centimeters long, and a centimeter in diameter, projecting into subcutaneous synovial bursae as well as into joints, or merely attached to their walls by relatively fine pedicles. Some of these masses suggest small lipomata. I also have observed so called synovial villi in rather large bursae, between the tendon of the triceps and the extremity of the olecranon. Most of these appendages were entirely similar to those seen so commonly in the shoulder and knee joints. Although traumatism from friction between the relatively

FIG. 28

Similar wear on a capitulum and the head of a left radius illustrating the correspondence in position of these lesions.

rough dorsal surface of the olecranon, with the periosteum of which the overlying inner wall of this subtendinous bursa fuses, and the outer wall of the bursa reduces the resistance of the coapted synovial surfaces to infection, the possibility that infection plays a part in the production of these villosities in this location is rather remote. If infection is always responsible for their presence, it is difficult to see why they are distributed in the bursae or on the inner surfaces of articular capsules, as they are.

I have never encountered any structures on the inner surfaces of articular capsules or on the walls of bursae, which answer to what could be regarded as proliferations from the synovial membrane. Such proliferations would of necessity have to be composed of connective tissue, for

FIG. 29

Still deeper wear accompanied by some polishing of these bones, in the area denuded of cartilage.

there is no structure which lines bursae or articular capsules which can properly be regarded as a membrane, and I believe that the time-worn conception of synovial villi must be abandoned. If so called synovial villi can result from proliferations following inflammatory processes or from so called synovial membranes assumed to line articular capsules, then we should expect to find similar proliferations on the inner surfaces of the synovial sheaths of tendons which so commonly are inflamed. I am aware, of course, that surgeons report the operative removal of synovial membranes from joints, but the prevalence of such procedures manifestly does not constitute adequate proof of the existence of membranes.

My contention is not that true outgrowths properly called villi have no existence but that they occur only rarely and always are few in number. Such fringes as are here considered and represented have, to my knowledge, never been found in the articulations of the newborn and it is evident that almost all the appendages commonly designated as synovial villi must hence develop later and therefore really belong in a different category than those present before birth.

For the convenience of those to whom the matters discussed in this article may be of further interest, I am appending a list of previous publications from this laboratory. And in order to leave no doubt in the minds of readers regarding the naked-eye appearance of the lesions here discussed, I am adding Figures 22, 23, 24, 25, 26, 27, 28, and 29, for they splendidly illustrate varying degrees of attrition in otherwise wholly normal joints.

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REPAIR OF RUPTURED QUADRICEPS BY FREE FASCIAL GRAFT TRANSPLANT*

BY HENRY MILCH, M.D., F.A.C.S., NEW YORK, N.Y.

Injuries to the quadriceps tendon involve so marked a disability to the patient that medical advice is sought within a relatively short time of the injury. Most of the cases of simple tearing of the muscle, being acute, present no great defect and usually require nothing more than suture of the torn ends to give fairly satisfactory results. In cases where the rupture is of longer duration with consequent contracture of the ends, or where the injury has been very extensive, the defect may be so great as to present a reconstruction problem of major magnitude. In the case described herewith, which was treated and reported through the courtesy of Dr. Harry Finklestein, a procedure was employed which we believe may be valuable in situations where large defects in the quadriceps tendon associated with active proximal muscle fragments are found.

L. M., female, white, age thirty-six, was admitted to the Hospital for Joint Diseases in September 1930, complaining of inability to extend her left leg on the thigh. The patient stated that on June 12, 1928, while descending a flight of stairs and while in the act of advancing her weight to the left foot, she had tripped and fallen forward with her left knee partly flexed. In the attempt to maintain her equilibrium upon that limb, her leg suddenly bent under her and she fell four steps to the landing. Her knee was flexed and could not be actively extended. Neighbors who were called picked her up and straightened her leg upon her thigh. It was then discovered that she could not walk. There was a large depression above the knee cap and the patient had to be picked up bodily and put to bed. Shortly after this the patient noticed that her knee became markedly swollen and the region about the knee ecchymotic. She remained in bed for six or seven weeks without treatment, and then was able to walk about with the aid of a cane. In walking up or down stairs she was forced to take one step at a time, using her right leg for the purpose of advancing. In spite of this disability the patient sought no treatment, and stated that on two separate occasions between the time of her first injury and the time of her admission to the hospital she injured her knee again while in the act of descending from a stepladder. On both of these occasions the left knee gave way under her and she was thrown to the floor.

On admission, the patient was not acutely ill, nor was there any tenderness or pain about the knee. She was extremely obese, weighing 230 pounds and standing five feet seven inches in her stockings. She was able to walk about with the aid of a cane, but complained of marked insecurity in the left leg. Apart from her obesity, no physical sign of disease elsewhere in the body was discovered. About one and one-half inches above the upper border of the left patella there was a distinct depression and a hiatus about two inches long (Fig. 1). The patella was freely movable. There was a noticeable atrophy of the left thigh and leg. The patient was unable to raise the leg from the bed, nor when sitting could she extend the leg on the thigh. Passively, the angle of greatest extension was 180 degrees, and the angle of greatest flexion 150 degrees. The urine showed a faint trace of albumin, but was otherwise negative. The

*From the Hospital for Joint Diseases, Orthopaedic Service of Dr. H. Finklestein.

FIG. 1
Before operation.

Wassermann test was negative. The basal metabolic rate was minus thirty-seven per cent. The blood examination showed:

Hemoglobin,	90 per cent.
White blood cells,	10,000.
Differential count:	
Polymorphonuclear neutrophils,	70 per cent.
Eosinophils,	5 per cent.
Lymphocytes,	25 per cent.
Sugar, 91 milligrams per 100 cubic centimeters.	

The diagnosis of rupture of the quadriceps tendon was apparent, and it was felt that some sort of plastic procedure might be necessary to overcome a defect of two inches, particularly in view of the long duration of the condition. Operation undertaken October 9, 1930, however, demonstrated the futility of any of the simpler plastic procedures such as simple lengthening of the tendon. When the site of the injury was exposed through a curved incision beneath the patella, and the flap thrown up, practically all of the distal end of the proximal portion of the rectus femoris was found to consist of a mass of fat which had infiltrated the muscle and maintained its normal contour. The lower fragment had similarly degenerated, practically down into its insertion into the patella. When this mass of fatty tissue was excised up to normal muscle there was hiatus of about ten inches to be bridged. The vasti internus and externus were found in good condition.

Confronted with this huge defect, a number of suggestions presented themselves for consideration. Any plastic procedure on the proximal portion of the rectus was out of the question because of the huge hiatus. A plastic lengthening of the patellar tendon had similarly to be dismissed because even if it had been possible to lengthen the tendon to the necessary extent, the result would have been to displace the patella so high up on the femur as to render it completely functionless. It was next proposed to detach the lower end of the tensor fascia femoris as low down as possible, separate this muscle up the thigh, then swing its lower end inwardly and attach it to the patella below and to the rectus femoris above. When this was attempted it was seen that although it might barely be possible to attach this tendon to the patella, the union would be none too

secure, and flexion of the leg would be hindered. Consequently, the lower ten inches of the tensor fascia femoris tendon and the iliofemoral band were cut free from the muscle and transplanted as a free fascial graft. To minimize the possibility of adhesions the gliding surface of the graft was kept facing downward against the vastus intermedius and the femur. It was carefully sutured with interrupted chromic mattress stitches to the quadriceps and vastus intermedius above, and to both vasti laterally and medially. The patella was then split tangentially, and the lower edge of the fascial graft inserted between and sutured in place all around the patellar edge. It was then possible to flex the knee about twenty-five degrees without any tension on the fascial graft. The skin was closed with continuous black silk sutures and a plaster-of-Paris bandage applied from the ankle to the upper portion of the thigh with the knee in full extension. To overcome any further tension, the thigh was flexed at the hip and held in this position in an overhead extension apparatus. The pathological report of the tissue removed showed a "marked atrophy of the muscle fibers with some evidence of slight interstitial myositis and fatty tissue replacement".

The convalescence was uneventful, and on November 12, at the first dressing, the wound was found to have healed by primary union. A note made at that time reads: "There appears to be very slight degree of power of the quadriceps tendon. The patient is to be given exercises for the development of the quadriceps tendon while lying in the prone position." On November 26 the patient observed definite increase in the strength of the muscle. In the sitting position she was able to flex the knee about forty-five degrees, and then actively extend it to 180 degrees (Fig. 2). In the early part of Decem

FIG. 2
After operation.

ber, the patient was permitted to begin walking about with the aid of a crutch, and in the middle of December she was discharged walking. When last seen she was even able to ascend stairs in the normal manner, using one leg after the other in normal progression. If the excessive weight of this patient is considered, it will be realized what a tremendous strain the muscle-fascial-graft extension apparatus must withstand in the act of extending the knee with the whole of the body weight resting on the injured extremity.

While we should have preferred to transplant the whole of the tensor fascia femoris, the case above presented demonstrates that even in the face of the most adverse conditions, the fascia lata can be utilized as a substitute tissue. Though we believe that in smaller defects the fascial graft is the method of choice, it might be well to consider the possibility of using the sartorius as an organ of substitution. In this latter case, of course it would be impossible to insure as firm an attachment of the thick muscle belly to the patellar edge as was obtained in this case by inserting the thin fascial lamina between the edges of the tangentially split patella.

RECURRENT DISLOCATION OF THE STERNOCLAVICULAR CARTILAGE

BY NORMAN DUGGAN, M. B., F.R.C.S., WORCESTER, ENGLAND

The condition to be described appears to be sufficiently rare to warrant a record.

The patient is a strongly built woman, aged thirty-seven. She gave the history that some three weeks previously, while she was making a bed, on turning a heavy double mattress, she felt a sudden pain in her left shoulder. At the same time she noticed a small swelling in front of the left sternoclavicular joint. She stated that the swelling disappeared in a few hours, but that it had reappeared several times since on movement of the shoulder. Since the original accident the shoulder had felt weak, and there had been fairly constant pain, referred, not to the site of the swelling, but to the region of the shoulder joint.

At the time of first examination, there was a small swelling over the left sternoclavicular joint, slightly movable, and corresponding in size to the intra-articular cartilage. A diagnosis of displaced cartilage was therefore made, and removal of the cartilage advised.

On her admission to the hospital a week later, the swelling had disappeared, but as the pain and disability persisted, the operation was performed the following day.

Operation June 24, 1930:—A short transverse incision was made over the joint, and carried down to the capsule. As the swelling was still absent, the arm and shoulder were moved, and immediately the meniscus popped out of a vertical tear in the anterior part of the capsule.

The displaced cartilage resembled in size and shape an avulsed finger-nail; it was attached above and below only, by two thin strands of tissue. These were sufficient to allow a considerable mobility through the rest of the joint; the surrounding capsule and ligaments seemed to be normal. The cartilage was removed, the rent in the capsule sutured, and the wound closed. Convalescence was uneventful, and full range of movement, with stability of the sternoclavicular joint, was noted on her discharge ten days later.

Three months after the operation she wrote, saying that the shoulder became tired at times but was improving, and all pain had disappeared.

The writer has found no reference to this condition in the literature.

FRACTURE OF THE METATARSAL BONES SIMULATING THROMBO-ANGIITIS OBLITERANS

Report of a Case*

BY PAUL W. LAPIDUS, M.D., NEW YORK, N. Y.

Assistant Adjunct, Hospital for Joint Diseases;
Assistant Surgeon, Hospital for Ruptured and Crippled

The rather unusual combination of the pathological changes and the misleading clinical picture presented in the following case seem to make it worth reporting.

Mr. J. E., age forty-four, was referred to the writer by his family physician on March 18, 1930. For the past six weeks, the patient had been complaining of constant burning pain in the third left toe. Recently the pain had become so severe that he was unable to sleep at night, and had lost about fifteen pounds in weight. On January 2, 1930, a heavy door had fallen across the dorsum of his left foot. For two to three days following the accident the patient had complained of pain in his left foot and had walked with a slight limp. During the following month the patient had been free from any symptoms. About one month after the injury the third left toe became painful and a small ulcer formed beneath the toenail. The patient consulted his family physician who made the diagnosis of thrombo-angiitis obliterans, and advised the application of an ointment. The patient stated that he could walk about ten blocks in spite of the pain in the third left toe. The patient's condition grew progressively worse, until he was referred to the writer on March 18, 1930. He gave a history of being in fairly good health until the onset of the present illness. Venereal disease was denied nor could he recall ever having frozen his feet. He had always been a heavy smoker.

On examination the patient appeared quite pale and in pain. The general physica examination was essentially negative. The left foot was swollen and presented several blisters on the dorsum (the result of the application of some irritating plaster by the patient's wife). The nail of the third toe was hanging loose and was easily removed during the first visit. There was a small ulcer over the distal part of the nail bed of the third left toe. The skin over the dorsum of this toe was dark gray, and skin sensitivity over the discolored area had disappeared. There was a very good pulsation in both dorsalis pedis arteries which were palpable on the outer dorsal aspect of either foot. The pulsation of the tibialis posticus artery could not be felt on either foot.

On March 19, 1930, the patient was admitted to the Hospital for Joint Diseases as a private patient. The blood examination showed:

Hemoglobin,	85 per cent.
White blood cells,	12,800.
Differential count:	
Neutrophils,	60 per cent.
Eosinophils,	3 per cent.
Lymphocytes,	33 per cent.
Mononuclears,	2 per cent.
Metamyelocytes,	2 per cent.

Wassermann test was negative; blood sugar was 100 milligrams per 100 cubic centimeters of blood.

*From the service of Dr. Leo Mayer, Hospital for Joint Diseases.

FIG. 1

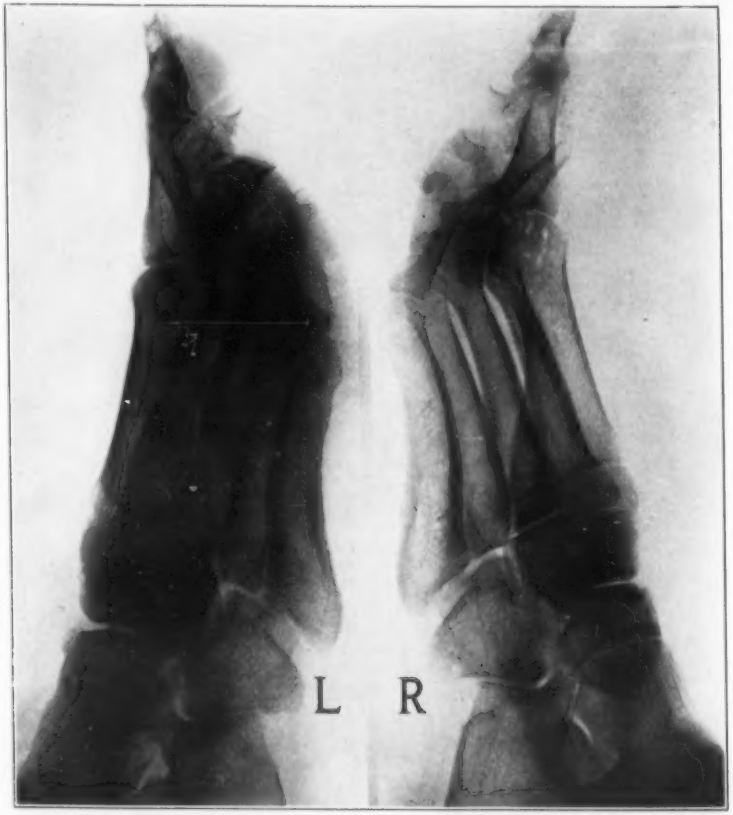

FIG. 2

United fracture of the second, third and fourth metatarsal bones (retouched). Note the large callus formation mainly over the shaft of the second with marked obliteration of the second and third intermetatarsal spaces. The normal foot is shown for comparison.

The roentgenograms of the left foot showed unsuspected united fractures of the shaft of the second, third, and fourth metatarsal bones.

During the first few weeks of hospitalization the patient experienced considerable pain in the third left toe which kept him awake at night. The gangrenous area of the skin on the third toe gradually became demarcated and sloughed off. There was an osteomyelitis of the distal and middle phalanges of the third toe with sequestration of the necrotic pieces of bone. The sequestra were easily removed when they became completely loose. The patient was treated with hot foot baths, wet dressings, and Bier's passive hyperaemia. In a few weeks pain in the left foot completely disappeared and the wound showed a slow tendency toward healing. On May 27, 1930, after about ten weeks of hospitalization, the patient was discharged from the hospital entirely free from pain and walking with his shoe on. A small granulating wound was still present over the dorsum of the third toe. This wound was quite stubborn in its healing, but finally became completely epithelized about three months after the patient left the hospital. In October 1930, the patient wrote that he had been perfectly well, working hard, all day on his feet, without any discomfort whatsoever.

Evidently in this case the fracture of the second, third, and fourth metatarsal bones, with hemorrhage between the fragments at first, and callus formation later on, caused compression of the second and third arteriae metatarsae dorsales and plantares. The third toe suffered most from lack of blood supply because all four of its arteries were located between the fractured metatarsal bones. Thus we were dealing with only a local impairment of circulation in the third toe with all its consequences,—as pain, gangrene, etc. This condition resembled so closely the one observed in thrombo-angiitis obliterans that this diagnosis seemed to be quite justifiable on the first examination. However, the absence of intermittent claudication with pain in the calves after a short walk (our patient could walk ten blocks), usually observed in cases of thrombo-angiitis obliterans, and the presence of good pulsation in both dorsalis pedis arteries made this diagnosis questionable.

Absence of pulsation on palpation of both tibialis posticus arteries, as in our case, is not at all uncommon and is not conclusive proof of their occlusion. Frequently it may be merely an indication of some anatomical variation in the location of these arteries.

SUMMARY

A case of fracture of the shaft of the second, third, and fourth metatarsal bones is reported. There was an evidence of mechanical impairment of circulation in the second and third arteriae metatarsae dorsales and plantares with lack of blood supply and gangrene of the third toe. The clinical picture closely resembled that in thrombo-angiitis obliterans.

TUBERCULOSIS AND KÖHLER'S DISEASE

BY D. M. FAULKNER, M.D., RICHMOND, VA.

Since the first description in 1908 by Köhler, of Wiesbaden, of a peculiar condition of the tarsal scaphoid in which the bone is abnormal in shape, size, and density, there has been much discussion as to the cause of this pathological change.

The cause is not yet established. As the disease is usually self-limited, operations for it have been rare and few pathological examinations of the affected scaphoid have been made. Most surgeons consider it similar to Legg's disease and to Osgood-Schlatter's disease. Ely[1] thinks it is a developmental anomaly of the tarsal scaphoid and states that patients with this disease always recover spontaneously.

Greenwood[2] is of a different opinion. In 1923 he described a typical case of Köhler's disease, but with this significant difference: In the roentgenogram the scaphoid showed the diagnostic picture of decreased anteroposterior diameter, increased density, and irregular shape, but in addition a tiny sequestrum could be seen lying near a corresponding hollow in the scaphoid. Recovery ensued under conservative treatment, but as the patient's parents had pulmonary tuberculosis and the patient later developed it, Greenwood believed that bacillus tuberculosis was the causative organism here. In a more recent article[3] he reports another case which was typical of Köhler's disease when first seen, but which progressed to a terminal condition of tuberculosis of the tarsus. In this case, the pneumococcus was obtained on aspiration, but when the foot was amputated the pathology was typical of tuberculosis with a secondary pyogenic infection.

He concludes that Köhler's disease is due to a blood-borne infection of low pathogenicity, that this name has been applied to an early and abortive infection of the tarsal scaphoid by the bacillus tuberculosis, and that the term "tarsal scaphoiditis" is in accordance with the known pathology of the disease.

Although an experience similar to that reported by Greenwood is not sufficient evidence to bring one to the same conclusion, it would seem deserving of record. At the time of observation, this case was considered unique, but just before operation Greenwood's second paper[3] was read and the "disastrous conclusion" in his case urged us to immediate operation.

The case report follows:

In May, 1927, a boy five years old, in good health, and with good family and past history, was brought to the office because a shoe salesman had told his mother that he was flat-footed. His mother said that he had been less active than usual lately and she thought it due to pain in his feet. At times she had noticed swelling just below the inner side of the left ankle with an accompanying limp.

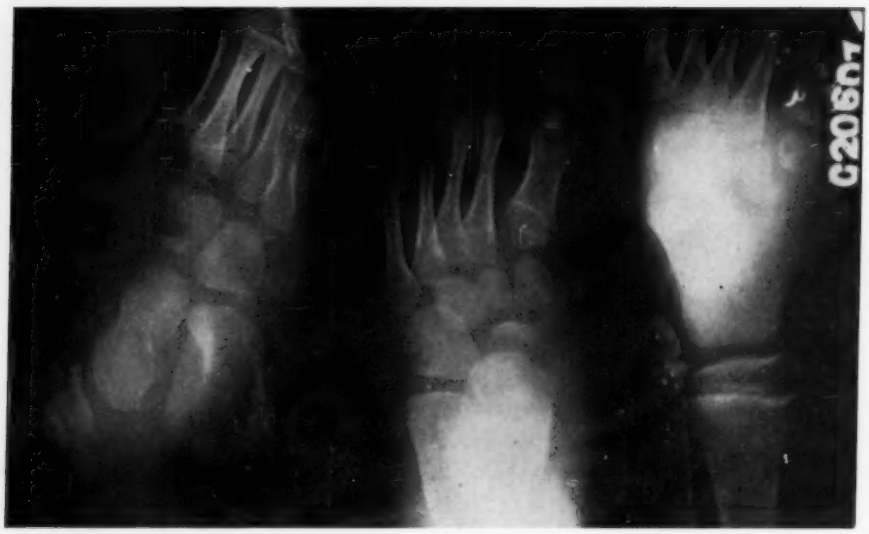

FIG. 1

Physical examination revealed nothing beyond extremely flat and pronated feet, with very prominent scaphoid tubercles. There was no tenderness over either scaphoid. Although the possibility of Köhler's disease was considered, the feet were not x-rayed, as the parents did not wish the expense of a radiogram. Felt arch supports and Thomas heels were prescribed, with improvement of the symptoms, though not of the appearance of the feet.

FIG. 2

In August, 1927, the child had tonsillitis. The following night he complained of pain in the left foot, was feverish, and the mother noticed swelling over the scaphoid. When he was brought to the office three days later, he could not walk and had a temperature of 101 degrees, with a dusky red swelling over the inner astragaloscaphoid region of the left foot which was acutely tender. There was inguinal lymphadenitis present. He was x-rayed by Dr. A. L. Gray who reported as follows: "Patient has very marked flattening and irregularity of the nucleus of the left tarsal scaphoid. Much soft tissue swelling is present in this region. The appearance of the scaphoid is that of Köhler's disease. There is, however, probably a recent infection present also." (Fig. 1).

The swelling and pain increased, and three days later a soft tissue abscess was opened and drained. No organisms were found by smear or by culture of the pus obtained. The acute condition was relieved and the child walked with crutches. But a sinus persisted and he was again x-rayed in November. This showed progressive destruction of the scaphoid, which appeared dense and honeycombed, as if the major portion of the bone were dead (Fig. 2). It was decided to remove the scaphoid, and two weeks later this operation was performed, with a pre-operative diagnosis of a probable tuberculosis of the scaphoid.

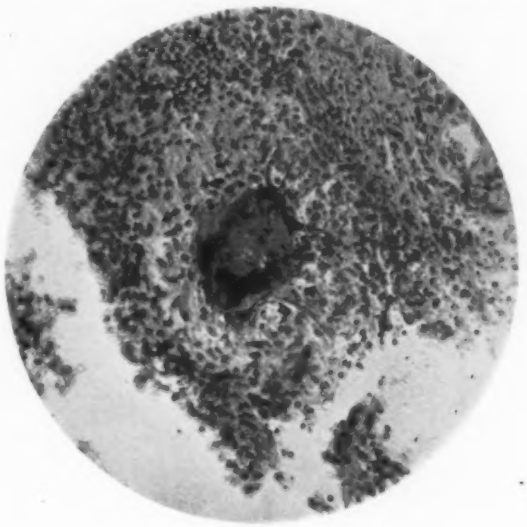

FIG. 3

Operation at St. Luke's Hospital, Dec. 14, 1927, Dr. Graham and Dr. Faulkner.—A three-inch incision was made in the long axis of the left foot over the inner dorsal surface, with center over the scaphoid. The soft tissues were elevated away and the scaphoid excised *en masse*. The bone had a softened necrotic center, but the cartilage seemed grossly in fair condition. It was sent to the pathology laboratory. An incision was made for counter drainage. Two rubber tissue drains were inserted and the angles of the incision were closed with interrupted sutures of equisitine.

The child left the hospital the next day. Healing occurred in about eight weeks. An x-ray examination April 25, 1928, showed the scaphoid missing. The centers of ossification of the other tarsal bones appeared normal. A small amount of calcareous deposit was seen in the soft tissues over the internal cuneiform bone.

Patient was allowed to walk June 15, 1928. When last seen, December, 1930, there were no signs of any disease in the foot. The foot was only slightly more flat and pronated than the other one, and there was excellent function except for inability to invert actively.

The pathological examination was made by Dr. S. W. Budd, who reported tuberculosis of the scaphoid. A photomicrograph of one typical field is shown (Fig. 3). Cultures made at time of operation showed the staphylococcus albus.

SUMMARY

A case is reported in which Köhler's disease was present. Following an acute upper respiratory infection, osteitis of the tarsal scaphoid was found,

which at operation later was proved due to bacillus tuberculosis. Whether this helps to confirm Greenwood's contention that bacillus tuberculosis is the cause of Köhler's disease or whether this case was merely tuberculosis occuring in a congenitally anomalous tarsal scaphoid, one cannot decide without further experience.

REFERENCES

1. Ely, L. W.: Köhler's Disease. Arch. Surg., XVI, 560, 1928.
2. Greenwood, H. H.: Köhler's Disease of the Tarsal Scaphoid. Lancet, II, 274, 1923.
3. Greenwood, H. H.: The Relation of Tuberculosis to Köhler's Disease. British J. Surg., XV, 245, 1927-1928.

A NEW KNIFE FOR OPERATIONS ON THE FOOT

BY D. H. O'DONOGHUE, M.D., OKLAHOMA CITY, OKLAHOMA
Oklahoma University School of Medicine

In the course of operating upon paralytic feet, especially in the removal of the astragalus, there has seemed to be some advantage in working through a single incision on the dorsolateral surface of the foot. However, we have found that in severing the ligamentous attachments of the astragalus, certain difficulty has arisen in reaching the internal ligaments without either severe twisting of the astragalus itself or severe traumatization of the soft structures of the foot.

It has been found that by using a knife with a suitable curve these difficulties can be minimized. For this purpose an ordinary scalpel (as illustrated) has been modeled with a definite curve on the flat surface of the blade as shown in the accompanying illustrations. This has proved very satisfactory since the curve of the blade may be made to follow closely the curve of the bone; and all attachments may be reached with minimum trauma to the foot and little danger of injury to such vital structures as might be endangered by the projecting point of a straight blade.

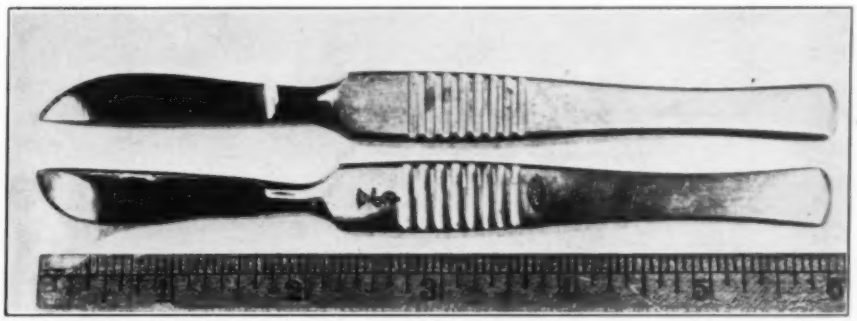

FIG. 1

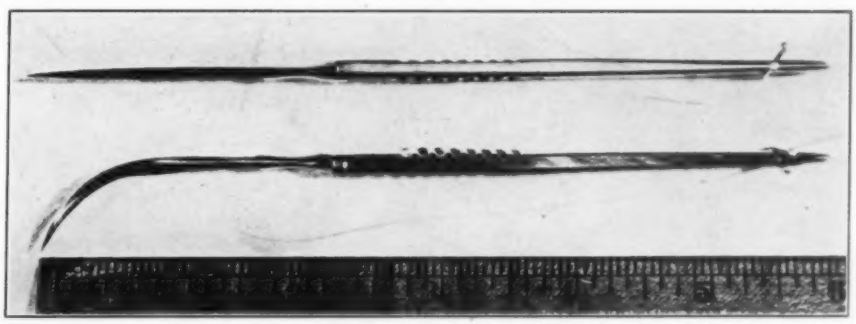

FIG. 2

The accompanying illustrations are self explanatory and show the curved knife in comparison to an ordinary scalpel. Of course the necessary measures must be taken to retemper and replate the knife following the modeling of the proper curve.

AN IMPROVED HUMERUS SPLINT FOR HOSPITAL USE

BY G. KENNETH COONSE, A.B., M.D., COLUMBIA, MISSOURI

From the Department of Orthopaedic Surgery of the University of Missouri

October 23, 1930, a method of treating fractures of the humerus by traction and mobilization was published in the New England Journal of Medicine and Surgery[1]. In connection with this treatment an improved splint has been developed by one of the authors. This splint is time-saving in application and does away with much of the cumbersome apparatus usually necessary to accomplish the result desired. It incorporates several new features. The arm ring is hinged, so that the arm can be placed in the splint and taken out without the necessity of pulling hand, forearm, and upper arm through the ring. The pulleys are an integral part of the splint and thus cannot be lost. They are mechanically much more efficient than the ordinary pulley used, having greater stability and less friction. The splint is attached to the bed by merely screwing on the two lower clamps shown in the illustration. These are adjustable and can be clamped on either a round or oval side piece and are thus applicable to any ordinary hospital bed. There is an adjustment which allows the splint to be raised or lowered by moving it medially or distally along the flat sides. Unlike the ordinary Thomas arm splint, the side pieces are made of flat metal drilled with holes at intervals of about one-half inch. These holes serve not only to make the necessary adjustments, but can be used in slinging the splint for the arm. It is also possible to use skeletal traction on humerus fractures by

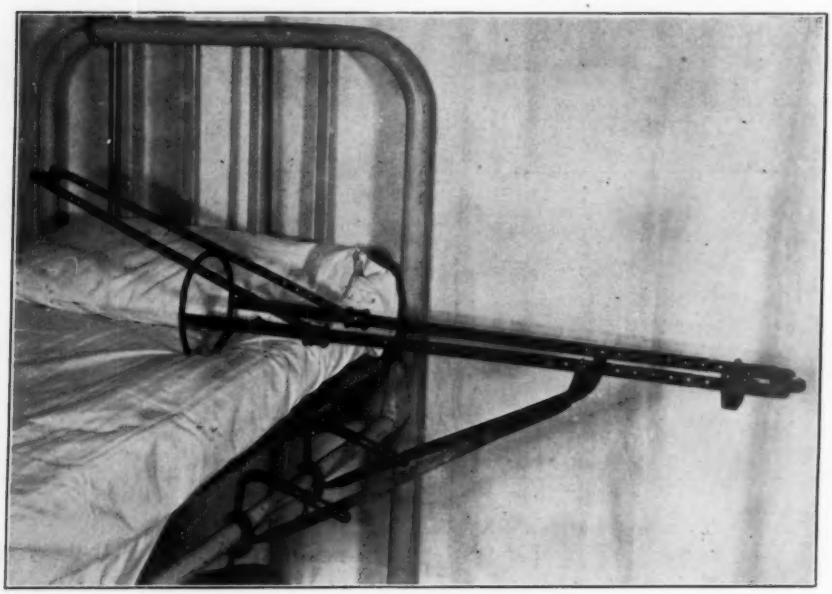

FIG. 1

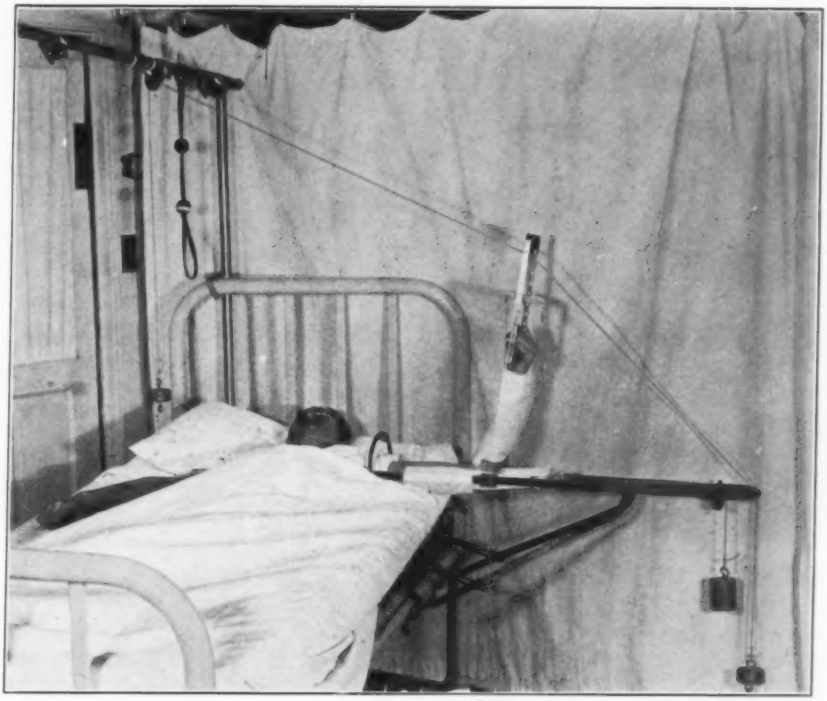

FIG. 2

this means. The patient can raise or lower himself in bed sufficiently to allow ordinary nursing care. The splint pivots on the two side supports as shown. The attachment for flexion of the arm has also been considerably improved. It is made of similar material and is attached to the arm splint by means of two removable plates. It in no way interferes with complete flexion and extension of the forearm and offers a minimal amount of resistance.

The splint is used with humerus fractures by counterbalancing the arm flexion apparatus by means of weights as herein pictured. There is, however, an attachment now in the process of manufacture which eliminates the counterbalancing with rope, pulley, and weights. Counterbalancing will then be accomplished as an integral part of the forearm flexion attachment and in this way the overhead frame, pulleys, ropes, weights, etc., are eliminated. There is also an attachment for use with skeletal traction.

This splint has proven very satisfactory and simple in operation. It requires practically no attention after once set up. It can be obtained through the University Hospitals, Columbia, Missouri. The writer wishes to acknowledge his indebtedness to Mr. Gus Tornsjo, Chief Technician, University of Missouri, for his help and cooperation in the preparation and manufacture of this apparatus.

1. COONSE, G. K. AND MOORE, H.: Treatment of Fractures of the Humerus by Mobilization and Traction. New England J. Med. CCIII, 829, Oct. 23, 1930.

A PIPE FRAME FOR TREATING FRACTURES OF THE LOWER EXTREMITIES

BY H. EARLE CONWELL, M.D., F.A.C.S., BIRMINGHAM, ALABAMA

Orthopaedic Clinic, Employees' Hospital, Fairfield, Alabama

This frame is being presented because of the following advantages:

The ease in adjustability.

The variety of uses for fractures of the lower extremities.

The simplicity and inexpensive construction.

The fixation to the bed, enabling the patient to be moved about without difficulty.

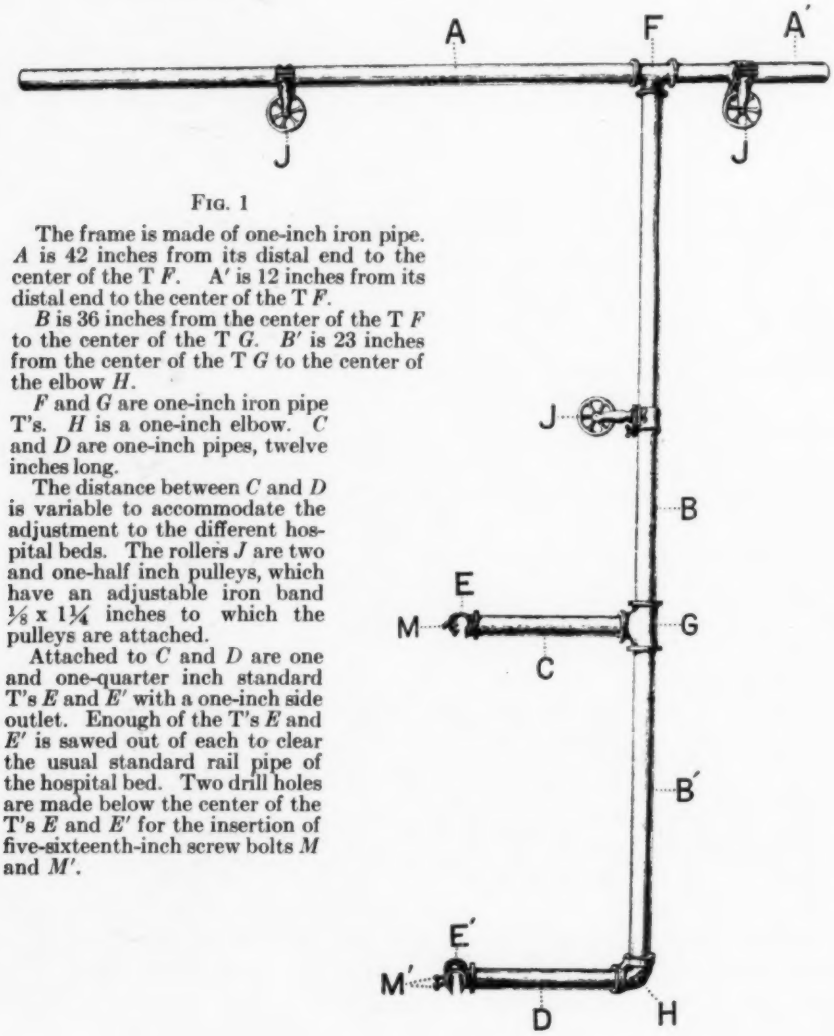

FIG. 1

The frame is made of one-inch iron pipe. *A* is 42 inches from its distal end to the center of the T *F*. A′ is 12 inches from its distal end to the center of the T *F*.

B is 36 inches from the center of the T *F* to the center of the T *G*. *B′* is 23 inches from the center of the T *G* to the center of the elbow *H*.

F and *G* are one-inch iron pipe T's. *H* is a one-inch elbow. *C* and *D* are one-inch pipes, twelve inches long.

The distance between *C* and *D* is variable to accommodate the adjustment to the different hospital beds. The rollers *J* are two and one-half inch pulleys, which have an adjustable iron band ⅛ x 1¼ inches to which the pulleys are attached.

Attached to *C* and *D* are one and one-quarter inch standard T's *E* and *E′* with a one-inch side outlet. Enough of the T's *E* and *E′* is sawed out of each to clear the usual standard rail pipe of the hospital bed. Two drill holes are made below the center of the T's *E* and *E′* for the insertion of five-sixteenth-inch screw bolts *M* and *M′*.

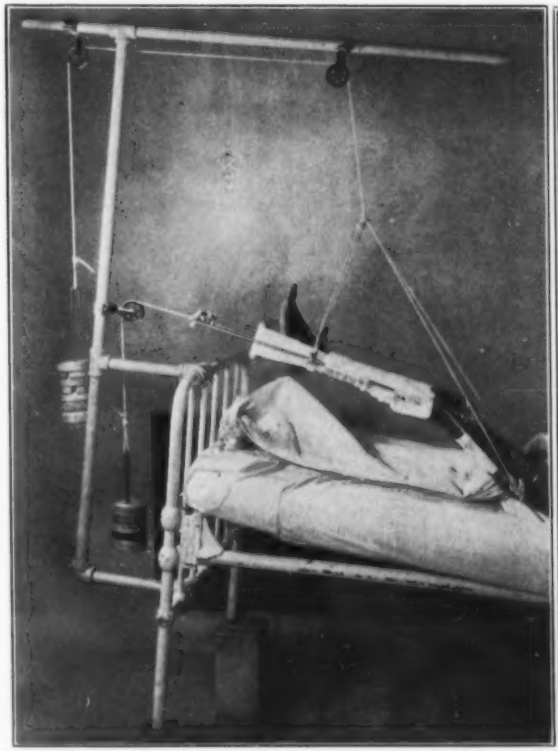

FIG. 2

Shows the use of the one-inch pipe frame for treatment of fractures of the femur by adhesive traction to the leg and suspension in a Hodgen splint. Skeletal traction can also be used with this frame either in the condyles of the femur, or upper third of the tibia, or about the ankle joint (See Fig. 4).

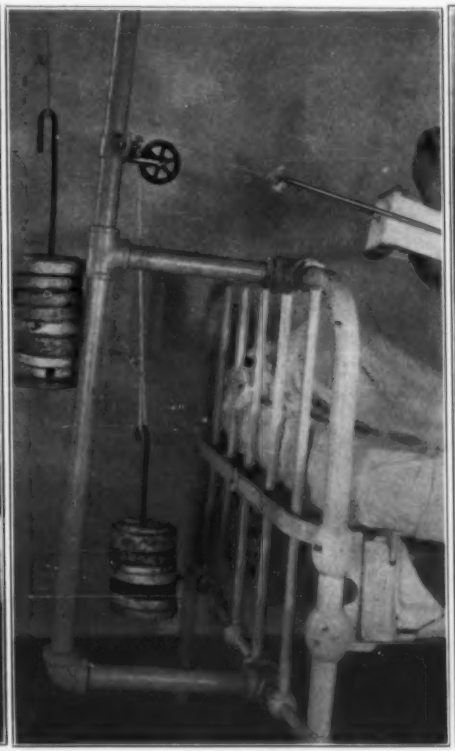

FIG. 3

Showing lower part of the frame attached to the bed with traction applied.

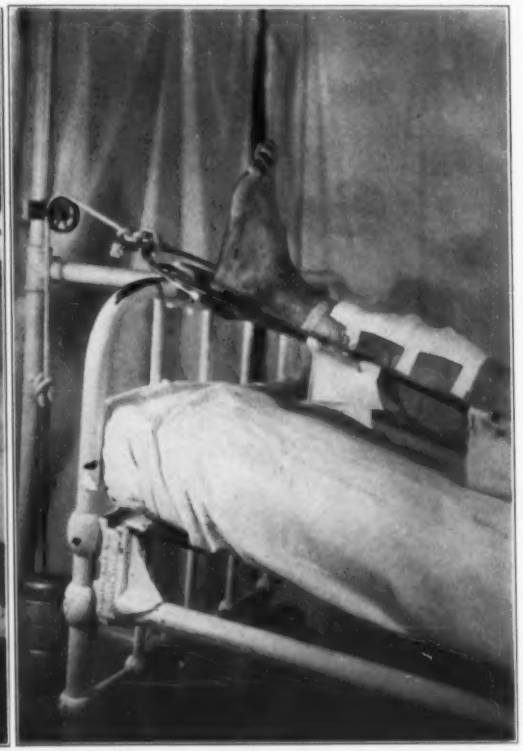

FIG. 4

Showing the method of obtaining skeletal traction through the os calcis, for certain fractures of the leg.

KNEE JOINT RETRACTOR FOR RESECTIONS AND ARTHROPLASTIES*

BY DANIEL H. LEVINTHAL, M.D., F.A.C.S., CHICAGO, ILLINOIS

The instrument described and illustrated herewith was designed by the writer several years ago, and has been used by Steindler, Campbell, and others. It has served to simplify to a considerable degree the operations of arthroplasty and resection of the knee joint.

The T-shaped handle is made of rounded steel, allowing a comfortable grasp with two fingers on each side of the upright which is six and one-half inches long and is flattened, and curved on the flat surface. The lower end or blade is a flattened fork or inverted Y, curved on the flat in the opposite direction to the curve of the shank.

The purpose of the instrument is to lever the femur forward and retract the tibia in shaping the femur, and to lever the tibia forward and retract the femur in shaping the tibia. The principle is that of a lever of the first class.

The technique of using the instrument is as follows: The tibia is separated from the femur. The knee is flexed to an angle of about ninety degrees. The ends of the prongs are impinged behind the femoral condyles at about the region of the inferior margins of the heads of the gastrocnemius. The shank rests against the anterior margin of the tibia. Downward pressure on the handle brings the lower end of the femur forward and forces the

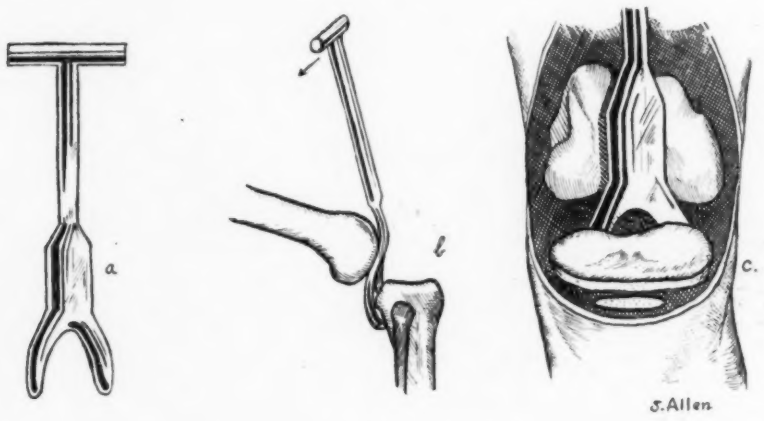

FIG. 1

a. Front view of the instrument. *b.* Lateral view demonstrating the use of the instrument retracting the femur, and bringing the tibial head forward. *c.* Front view, showing the generous exposure of the upper surface of the tibia and the retraction of the femur and the popliteal structures.

*From the Orthopaedic Department, Michael Reese Hospital.

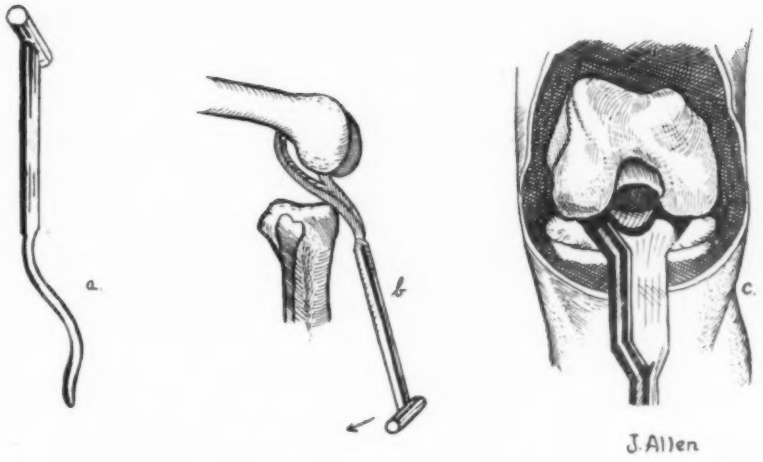

FIG. 2

a. Side view of the instrument. *b.* Schematically demonstrating the use of the instrument, lateral view, retracting the tibia and bringing the femoral condyles forward. *c.* Front view, showing the complete exposure of the femoral condyles, retraction of the tibia, and protection of the popliteal structures.

tibia and the important popliteal structures backward (Fig. 2). In performing a resection of the knee joint, the instrument used as described above facilitates the use of the saw, and permits the operator to cut the posterior portion of the femur as accurately as the anterior without danger to the retro-articular structures. In performing an arthroplasty, gouges of various sizes and shapes are used to reshape the bone. The projection of the lower end of the femur permits adequate posterior reshaping of the condyles, and facilitates very high posterior attachment of the interposing fascial transplant. This favors a better range of flexion in the end result. When the instrument is reversed,—that is, with the prongs impinging behind the tuberosities of the tibia and the shank resting on the patellar facet of the femur, pressure on the handle toward the anterior surface of the thigh brings the tibia forward and retracts the femur and the popliteal structures (Fig. 1). The upper end of the tibia can now be sawed across through the full thickness of the bone without endangering the retro-articular structures; or if an arthroplasty is being performed, the pedestal or base of the new joint can be thoroughly shaped with gouges of various sizes and shapes.

News Notes

The Forty-fifth Annual Meeting of the American Orthopaedic Association will be held in Memphis, Tennessee, April 15 to 18, 1931. Headquarters of the Association will be at the Hotel Peabody. The preliminary program is as follows:

WEDNESDAY, APRIL 15

Morning Session—Memphis Country Club:

Clinical presentations. Dr. Willis C. Campbell and Staff—Dr. J. S. Speed, Dr. Jos. I. Mitchell, Dr. J. F. Hamilton.

Afternoon Session

Golf tournament for members and guests, arranged by Dr. Charlton Wallace.

THURSDAY, APRIL 16

Morning Session—Hotel Peabody Ballroom:

Symposium on Backache:

Anatomical Considerations	DR. THEODORE A. WILLIS.
Orthopaedic Aspect	DR. LLOYD T. BROWN.
Surgical Aspect	DR. EDWAIN W. RYERSON.
Gynecological Aspect	DR. FRED L. ADAIR.
Neurological Aspect	DR. WALTER E. DANDY.
Urological Aspect	DR. GEORGE R. LIVERMORE.
Industrial Aspect	Speaker to be announced.

Afternoon Session

Open Reduction of Congenital Dislocation of the Hip DR. FREDERICK C. KIDNER

A New Departure in the Treatment of Congenital Dislocation of the Hip DR. ARTHUR KRIDA.

Cystic Disease of a Vertebra with its Relationship to the Arterial Supply DR. DEFOREST P. WILLARD.

FRIDAY, APRIL 17

Morning Session

President's Address	DR. WILLIS C. CAMPBELL.
Certain Desmogenous Tumors of the Hand and Foot	DR. ALBERT H. FREIBERG.
Fractures of the Cervical Spine	DR. JAMES O. WALLACE.
Treatment of Fractures of the Os Calcis	DR. KELLOGG SPEED.
A New Approach to the Radical Surgical Treatment of Osteomyelitis of the Os Calcis	DR. FREDERICK J. GAENSLEN.
Liver Diet in Amyloid Degeneration	DR. BRAINARD WHITBECK.

Afternoon Session

An Operation for the Correction of Extremely Relaxed Flat Feet DR. MICHAEL HOKE.

Pathological Mechanics of Hand and Finger Contractures DR. ARTHUR STEINDLER.

Contractures of the Hand Resulting from Infections and Injuries
Dr. Sterling Bunnell.
Gelatinous Finger Nodules in Osteo-arthritis Dr. I. William Nachlas.

Saturday, April 18

Experimental Study of the Distribution of the Peripheral Blood Flow
Dr. Barney Brooks.
Arthritis: Indications for and Results of Sympathetic Ganglionectomy and Trunk Resection Dr. M. S. Henderson.
Dr. A. W. Adson.
Treatment of Vascular Diseases of the Extremities by Sympathectomy
Dr. D. E. Robertson.
Congenital Elevation of the Scapula Dr. Robert D. Schrock.
The Use of the Anterior Superior Spine in Hip Surgery:
(1) Arthrodesis; (2) Shelf Operation for Congenital Dislocation
Dr. Ralph K. Ghormley.

Dr. David M. Bosworth announces the removal of his office to 58 East 65th St., New York, N. Y.

Dr. Andrew P. Cornwall announces the removal of his office to 371 Commonwealth Ave., Boston, Mass.

At a meeting of the Board of Trustees of the Hospital for Ruptured and Crippled, New York City, held Friday, February 13, Dr. Armitage Whitman was appointed Surgeon to the Hospital.

On January 25, at the University Clinic for Orthopaedic Surgery, Frankfort, Germany, the busts of Hoffa and Biesalski were unveiled. Addresses were made by Prof. Hohmann, who is now in charge of the University Clinic, and by Prof. Schanz, one of the oldest pupils of Hoffa. Many of the former assistants of Prof. Hoffa and Prof. Biesalski took part in the proceedings.

Announcement is made of the opening of **The Orthopaedic Hospital of Shanghai**, China, which has been developed under the leadership of Dr. W. S. New.

Dr. LeRoy C. Abbott, formerly of the Shriners' Hospital for Crippled Children in St. Louis, has been appointed Professor of Orthopaedic Surgery at the University of California. This appointment became effective July 1, 1930.

The University of Bordeaux, France, announces a post-graduate course to be given by members of the Faculty under the direction of Prof. Rocher, on the general and orthopaedic surgery of children. This course is from June 1 to June 9, inclusive. Applications can be made to the Secretary of the Faculty.

The New York Polyclinic Medical School and Hospital, which was organized in 1881, has opened its new twelve-story addition. This will provide better facilities for teaching and additional space for clinics, as well as increasing the space for wards and out-patient departments.

The dedication of the new **Shriners' Hospital for Crippled Children** in Honolulu took place on November 27, 1930.

At recent meetings of the Executive Committee of the **British Orthopaedic Association,** the following were elected Full Members:

A. Chance, 90, Merrion Square, Dublin.
Harry Meade, 9, Fitzwilliam Place, Dublin.
William Pearson, 31, Fitzwilliam Place, Dublin.

The following were elected Associate Members:

W. J. Eastwood, 21, Druidsville Road, Menlove Avenue, Liverpool.
A. Thos. Fripp, 19, Portland Place, London.
A. M. Hendry, 26, Allenscroft Road, King's Road, Birmingham.
G. A. Q. Lennane, Bretby Hall Orthopaedic Hospital, Nr. Burton-on-Trent.
David Levi, 15, Harley Street, London.
Leslie Morris, 7, De Montfort Street, Leicester.
R. W. Reid, North Hill House, Colchester.
Pierre Roux, Glenconnor, Kenilworth, Cape Province, South Africa.

The results of the examination for the degree of M. Ch. Orth., in Liverpool, have recently been published. The list of men who have qualified is as follows:

A. C. Armstrong, Sydney.
J. C. Drummond, Liverpool.
L. W. A. Gibson, Sydney.
M. K. Hussein, Cairo.
P. Roux, Capetown.
V. J. Taylor, Liverpool.

The Annual General Meeting of the British Orthopaedic Association was held in London on Friday and Saturday, November 28 and 29, 1930.

Mr. R. C. Elmslie chose as his subject for the Presidential Address, "Pathology in Relation to Orthopaedic Surgery". A very stimulating review was given of recent developments in the pathology of muscles, tendons, bones, and joints. A greater concentration by the orthopaedic surgeon on the pathological aspect of his work was pleaded for, and a closer cooperation between the pathologist, the biochemist, and the orthopaedic surgeon urged. Dr. L. Böhler of Vienna, by invitation opened a discussion on fractures of the lower extremity, and illustrated by cinematographic films and lantern slides the methods which he has perfected for the anatomical reduction of fractures. He described the methods of local anaesthesia for fracture treatment, reduction by skeletal traction, immobilization by unpadded plaster casts, muscle development by active exercise and early weight-bearing, and control of oedema by elastic support and continued functional use. The treatment of non-union of fractures by multiple drilling received a new impetus when it was seen that in his hands, combined with the "functional treatment" which is so essentially part of his program, complete success had been secured in a large proportion of cases.

Böhler's principle of continual functional use with the prevention of lateral sheering strains which has been so successful in treating even long standing ununited fractures of the carpal scaphoid, was further illustrated in two cases he reported of old ununited fractures of the neck of the femur. After a subtrochanteric osteotomy, planned so mathematically as to correct the alignment of the neck of the femur with complete accuracy, the resulting abolition of sheering strains combined with functional use had terminated in filling of the cavities, recalcification of the neck, and complete union of the fractures.

In the afternoon there were clinical demonstrations and operations at King's College Hospital by Mr. H. A. T. Fairbank and Mr. St. J. Buxton.

The Association Annual Dinner was held in the evening, and Dr. Böhler was the guest of honor.

The morning session of the second day was devoted to the reading of short papers.

Mr. D. McCrae Aitken gave an account of the methods he had adopted to stabilize pathological dislocations of the hip joint. He said that in the normal patient a vertical line through the thigh and hip joint, if carried upwards, runs through the sacro-iliac joint, and in the lateral view through the body of the fifth lumbar vertebra. In pathological dislocations the femur is displaced so that the line of weight-bearing passes to the outer side of the sacro-iliac joint and behind the fifth lumbar vertebra. This accounted for the tilt of the trunk in walking and for much of the patient's disability. The object of treatment should be to restore the normal alignment, and to some extent this could be secured by gouging out a socket in the side of the pelvis, securing as much forward and inward reposition as possible. Provided that a good trochanter was reconstructed as in the Whitman operation, a very shallow acetabulum and a small roof sufficed. Stabilization by such means was advised as early as possible after quiescence of the infection in order to promote growth of the shaft of the femur.

Mr. H. A. T. Fairbank demonstrated his operation for the reconstruction of the upper lip of the acetabulum in congenital dislocation of the hip, by a cinematographic film. After manipulative reduction of the dislocation, the capsule of the joint was exposed by the Smith-Petersen incision. The joint itself was not opened because this had been found to predispose to arthritic change later in life. An osteoperiosteal flap was cut with its base as near the true acetabulum as possible, and wedged down by means of a curved graft cut from the ilium and fixed by three ivory pegs. Fragments of bone were also packed in, to increase the stability.

Mr. B. Macfarland showed a film which demonstrated slight modifications of the operation. The new lip was wedged down by the spring of a graft bent into the shape of a V. Patients were seen standing, walking, and running, before and after treatment. Weight-bearing was allowed after five months, and it had been found that patients who at first had considerable stiffness of the hip eventually secured the best results.

Mr. Girdlestone advised removing the capsule and synovia beneath the new lip because it was thought possible that compression of these structures between the femoral head and the acetabular rim might give rise to symptoms.

Dr. L. Böhler described the treatment he had used for compression fractures of the spine. The method was that of A. G. Davies, of Pennsylvania, except that a local anaesthetic was employed by injecting novocain through a needle inserted obliquely inwards from a point three fingers' breadth from the middle line. Hyperextension was maintained by the heel suspension method for as long as thirty minutes. Dr. Böhler's advocacy of "functional" treatment was excellently illustrated by a film showing patients in plaster jackets practising exercises for the erector spinae.

Mr. Watson Jones said that during the last two years he had treated eight cases by a very simple procedure which had been found just as successful as the more severe methods in restoring the compressed vertebra to its original shape. The patient lay face down with the head and arms supported on a table which was about eighteen inches higher than another table supporting the thighs and legs. The trunk sagged between the two points of support; body weight was sufficient to secure anatomical reduction,

and the same position facilitated the immediate application of a plaster jacket. A general anaesthetic was not advisable, and since patients complained only of some discomfort in the arms and not of any pain in the back a local anaesthetic was considered unnecessary. Excellent results had been secured and six of the eight patients had resumed their normal occupations within six months.

Mr. P. B. Roth read a paper on displacements of the epiphysis of the capitellum, demonstrating by an ingenious diagram how the rotation of the fragment prevented union and eventually led to cubitus valgus deformity. He advised operative treatment in all cases.

Mr. Lindsay reviewed the literature on the subject and reported results in two cases he had operated on. Full movement had not been restored but the functional results were better than with conservative treatment.

Mr. Girdlestone gave a résumé of a paper on "The Operative Treatment of Pott's Paraplegia". The complication of paraplegia appeared much more commonly in the adult than in the child, and in a large proportion of cases remained stationary with conservative treatment. In all such cases laminectomy was advised. Since removal of the posterior arches in the area where vertebral bodies were destroyed involved considerable risk of instability of the spine, the procedure should always be combined with bone grafting as well as complete external splinting. A curved graft was fused with the spinous processes above and below the area of laminectomy, forming a bridge across the gap. The graft had the further advantage of preventing the grinding movement associated with each respiration, which increased the destruction of the diseased bone. In about half of the cases laminectomy was combined with costo-transversectomy and evacuation of the abscess, and sometimes the abscess was evacuated without a laminectomy. The practice of bone grafting without preliminary laminectomy was strongly deprecated, because if it subsequently became necessary to perform a laminectomy the operation was rendered difficult and dangerous. The results of laminectomy and bone grafting for Pott's paraplegia were reported in eleven cases, and all had been either cured or very much improved.

The annual meeting of the **North Pacific Orthopaedic Society** was held in Tacoma, Washington, on December 20 and 21, 1930. This Society includes all the orthopaedic surgeons of British Columbia, Oregon, Utah, and Washington.

Dr. Edward A. Rich, of Tacoma, was elected President, and Dr. Harry C. Blair, of Portland, Secretary; Dr. Frank P. Patterson was chosen President-Elect, and Dr. LeCocq Secretary. It was decided to hold the 1931 meeting in Vancouver, on Labor Day.

The following papers were presented:

The Return to Buck's Extension, by Dr. Carlson, of Portland.
Synovectomy, by Dr. Dillehunt (paper presented by Dr. Lucas).
The Autogenous Vaccine Therapy of Arthritis, by Dr. Jeffery, of Seattle.
Coxa Vara, by Dr. Adams, of Spokane.
Intercondylar Dislocation of the Patella, by Dr. Akin, of Portland.
Xanthomatosis and Related Conditions, by Dr. Blair, of Portland.
Fractures of the Femur in Children, by Dr. LeCocq, of Seattle.
Classification of Fractures of the Ankle, by Dr. Lucas, of Portland.
Osteochondritis of the Spine, by Dr. Murray, of Seattle.
Industrial Fractures, by Dr. Frank Patterson, of Vancouver.
Dislocations of the Cervical Vertebrae, by Dr. Eikenbary, of Seattle.

In his address, the President stressed the point that the subject of arthritis is the concern of the orthopaedic surgeon primarily, and reviewed the literature and emphasized the need for a more vigorous attack of the problem.

PATHOLOGICAL CONFERENCE AT THE HOSPITAL FOR JOINT DISEASES, NEW YORK CITY, DECEMBER 17, 1930

A Case of Chronic Arthritis and Synovitis of the Knee with Joint Mice.

Dr. Harry Finkelstein presented a specimen consisting of a rice body, and in addition a section of synovial membrane showing evidences of villous synovitis, some of the villi being pinched off, resembling early rice-body formations (Fig. 1).

The patient, a male, fifty-one years old, whose father died of pulmonary tuberculosis at forty-eight, was admitted to the hospital Nov. 13, 1930, the chief complaint being pain and swelling of the left knee of two years' duration. During this period there were several attacks of knee locking, without a previous history of trauma. The last attack began ten days previous to admission; the knee suddenly swelled, there being a sense of heaviness without actual pain. Prior to this attack there had been a five months' period free of symptoms.

Physical examination revealed a well nourished white male, not acutely ill, who walked with a slight limp on the left side. The motions of the left knee were free and painless; no local heat; slight crepitation on motion. The knee was enlarged, patellar ballottement present. Measurements:

	Right Knee	*Left Knee*
Suprapatellar	16 inches	16½ inches
Midpatellar	14½ inches	16½ inches
Infrapatellar	13½ inches	14 inches

Laboratory study showed urine, Wassermann, G.C. fixation, and quantitative tuberculin tests negative. Fluid aspirated from the knee was also negative in all respects.

X-ray examination showed evidences of osteo-arthritic changes, with several joint bodies, one in the quadriceps pouch appearing free; another over the outer tuberosity of the tibia seemed to be separating from the rest of the bone, giving the impression of an osteochondritis dissecans.

Fig. 1

Operation Nov. 20, 1930: parapatellar incision, synovectomy. The synovial membrane was thickened, oedematous, and inflamed in places. Several thickened areas gave the impression of cartilaginous deposits within the synovial membrane. A fibro-cartilaginous body about the size of a small cherry was observed in the quadriceps pouch. There was an erosion over the cartilage of the external condyle of the femur about three-quarters of an inch square. The remaining joint structures were essentially negative.

Sutures were removed nine days following operation. Wound healed by primary intention. Patient was discharged Dec. 15, 1930. Angle of greatest extension, 180; angle of greatest flexion, 145. General condition excellent. No pain or swelling of left knee.

FIG. 2

MICROSCOPIC EVIDENCES OF HEALING IN TORN SEMILUNAR CARTILAGES.

Dr. Harry Finkelstein presented two specimens of removed internal semilunar cartilage of the knee, both of which showed definite evidences of attempts at healing. The first case was that of a male, aged twenty-five, admitted to the hospital Nov. 27, 1930, whose chief complaint was locking of the right knee, duration seventeen months. There was a history of a fall down a flight of steps, with resulting pain, swelling, and locking of the knee. An attempt to straighten the knee at that time failed; patient remained in bed three and a half weeks, and subsequently walked with a limp for six weeks. Following this attack there were five repetitions, the last ten days previous to admission. Laboratory and x-ray examinations were negative.

At operation, Nov. 28, 1930, the internal semilunar cartilage was found to be torn in two places transversely, and in addition there was a longitudinal circumferential tear of the cartilage into two halves, the outer half being displaced and in contact with the crucial ligaments. Pathological examination (Fig. 2) showed a healed lacerated semilunar cartilage with traumatic necrosis (Dr. Jaffe). The specimen was torn during the preparation, but on

FIG. 3

either side of the tear are distinct evidences of connective-tissue scarring with attempts at healing.

The second case was that of a female, aged twenty-eight, admitted Nov. 3, 1930, who likewise had sustained a fall ten months previously, resulting in severe pain and inability to straighten the right knee. This was followed by three subsequent attacks in the same knee, and during the four weeks before admission the patient had had excruciating pain in the knee, which was considerably swollen and held in a position of slight flexion, requiring support while walking. Examination showed a swollen knee, the bony landmarks obliterated, exquisite tenderness on pressure over the internal semilunar cartilage. Angle of greatest extension, 150; angle of greatest flexion, 135. Urine, blood, and x-ray examinations were negative.

At operation, Nov. 6, 1930, the internal meniscus was found displaced and quite loose. There was a tear of the middle of the body of the cartilage of a bucket-handle type. Pathological examination (Fig. 3) showed vascular fibrous healing of an old tear of the semilunar cartilage (Dr. Jaffe).

Despite the generally accepted theory that cartilaginous structures possess poor healing power, these two specimens suggest that in the presence of minor injuries at least temporary healing may occur in rare instances.

NEUROFIBROMA OF THE POSTERIOR TIBIAL TENDON.

Dr. E. Kaplan presented the following case from the Service of Dr. Finkelstein.

The patient, a male, thirty-two years old, came to the clinic with a small nodule around the medial aspect of the left foot which he had noticed first about two years previously. It was very painful to touch but had not increased in size during this period. There were also two larger masses over the outer aspect of the same foot, but these did not trouble the patient. On examination of the foot, a small, easily movable mass was recognized below and slightly behind the internal malleolus; it was hard and extremely painful when moved or touched. The dorsolateral aspect of the foot presented

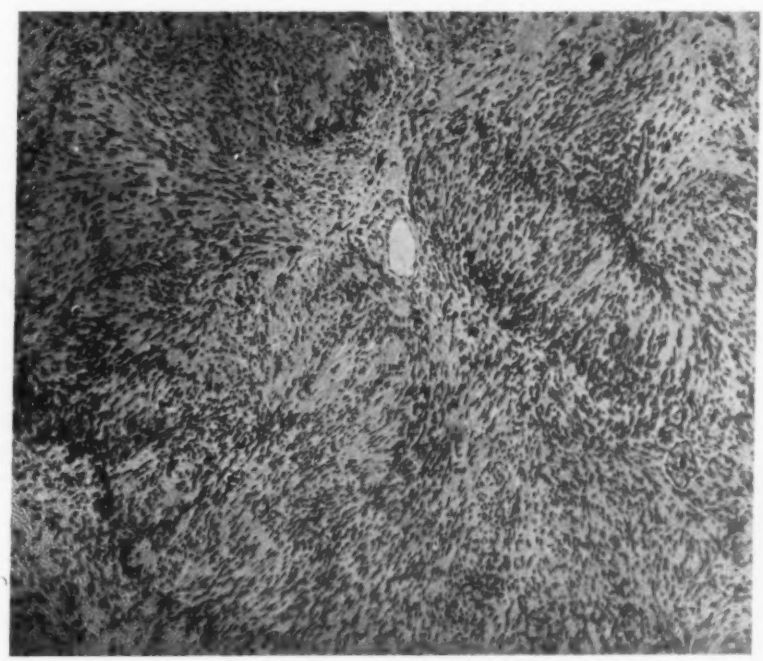

FIG. 4

two hard masses firmly connected with the bony structure of the foot. No nodules or formations were found elsewhere.

On operation the outer masses proved to be osteomata. The medial nodule was approached through a two-inch incision below and behind the medial malleolus; the posterior tibial tendon was exposed and brought forward, the nodule located in the depth of the tendon, distending it slightly, and shelled out through a longitudinal incision of this tendon. It was an encapsulated, elongated, elastic, grayish, and translucent mass. The following report was submitted by Dr. Jaffe: Specimen (Fig. 4) consists of a small piece of tissue, one and three-fourths by one centimeter in diameter. It cuts easily. Section shows a typical palisade arrangement of the cells. In places there is a mucilaginous degeneration and hemorrhages. Diagnosis: neurofibroma around ankle.

This case is interesting because it evokes the question of nerve distribution in the tendons. There are two types of nerve endings,—the simple interstitial, non-encapsulated, situated in the loose connective tissue among the tendon bundles, and the compound epithenal, which are similar to the neuromuscular spindles and are situated at the very border of the muscular tissue. Apparently the above described tumor originated from one of the interstitial endings, as it was found at a distance from the muscular part of the tendon.

NEUROFIBROMA OF THE HEEL.

Dr. A. B. Pemsler presented the following case: H. S., male, aged forty-two; previous history negative. Present history: About eleven years ago patient first noticed a growth under the left heel. This kept increasing in size, and five years ago began to cause pain. Pain is only slight when patient walks, but seems to be influenced by weather changes. No other growths ever present.

Physical examination was negative, except for tumor on left heel. This was about three inches in the anterior-posterior, two inches in the lateral, and one-half inch in the vertical diameter, of solid consistency, and apparently adherent to the overlying skin and to the deep tissues. Tenderness was present in the central portion of the mass, and the skin in this area showed two small skin ulcerations.

FIG. 5

Operation: A horseshoe incision was made following the contour of the heel, and about one inch above the plantar surface. A tumor of firm consistency was exposed, and dissected from the deep tissue and skin, to both of which tissues it was strongly adherent. No distinct capsule was found surrounding the growth. After the main mass was enucleated, several small nodular masses were expressed by hand from the subcutaneous tissue. A strip of skin one inch wide was removed, and the wound closed in

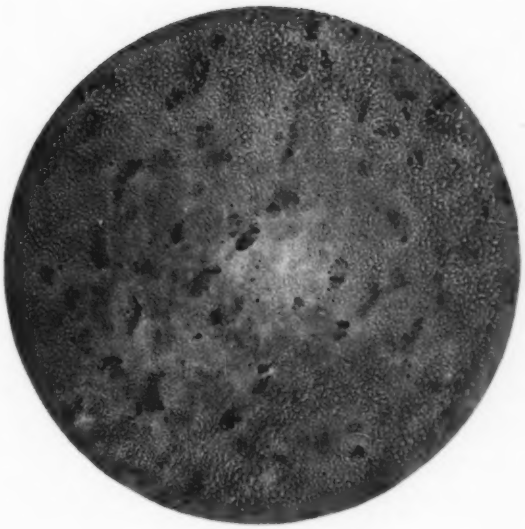

FIG. 6

layers, the deep tissues with catgut, the skin with silk. A pressure pad was applied to help eliminate dead space where the tumor had been removed. X-ray showed a soft swelling about the size of a lemon on the plantar surface of the left foot immediately below the distal half of the os calcis. No bone production was present. The bones of the foot proper show no involvement. Laboratory report: Neurofibroma with secondary degeneration and calcification (Figs. 5 and 6).

HEMATOMA ON DORSUM OF FOOT WITH BONY TRANSFORMATION.

Dr. H. C. Stein presented a patient, H. F., female, aged forty-nine, admitted to the hospital Dec. 4, 1930. Four weeks previously patient noticed a small swelling on the dorsum of the right foot. There were no subjective symptoms. There was another mass in the left axilla which had been previously removed at another hospital, but had recurred. The tumor on the foot measured about one centimeter in diameter, and had not increased in size since first observed. It was situated on the dorsum of the right foot, neither attached to the skin nor underlying structures, and freely movable. It was neither tender nor discolored, but of firm consistency.

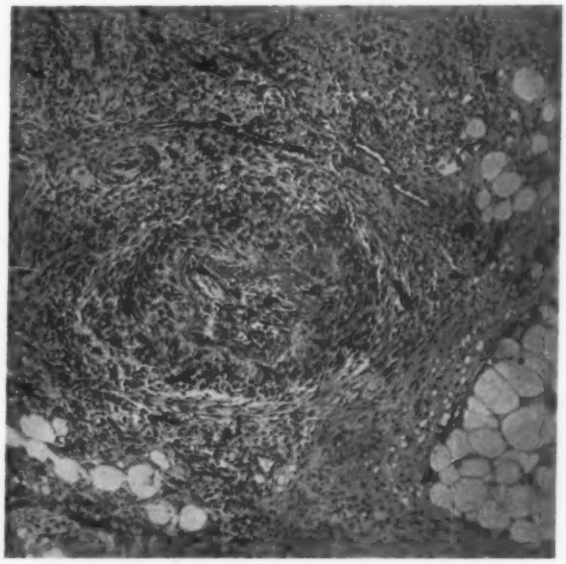

FIG. 7

At operation, an incision was made directly over the mass. It was impossible to shell out the tumor intact, as it was not encapsulated but quite friable. The tumor was in the subcutaneous tissues directly over the extensor tendons, but not adherent to them. The pathological report by Dr. Jaffe was as follows: Gross specimen consists of a number of small pieces of fatty tissue. Microscopic section shows a fibro-fatty tissue. The connective tissue shows inflammatory organization with numerous newly formed connective-tissue cells. In the specimen are two small areas of heterotopic bone formation. The lesion may be due to an old hemorrhage. Diagnosis: Chronic inflammation of the subcutaneous tissues on the dorsum of the foot with early heterotopic bone formation (Fig. 7).

At the meeting of the **Réunion d'Orthopédie et de Chirurgie de Appareil Moteur de Bordeaux,** on November 27, 1930, Dr. Charles Lasserre reported a case of "Cervical Arthritis and Traumatism". The rôle of traumatism in the vertebral pathology deserves attention, particularly since frequently these traumas may be slight and may pass unnoticed both by the patient and by the surgeon.

In illustration of this, in 1924, a patient of sixty-three years, with rheumatic symptoms of some duration, received a blow on the left shoulder, which left a sequela of limitation in the elvation of the arm. In 1927 there appeared a tingling sensation in the neck and the radial shoulder of the left arm and hand. In 1929, two hours after severe trauma of the spine and the posterior part of the neck, there developed particularly severe cervical pain and an irreducible torticollis. Three weeks later the torticollis had disappeared, but in stages there appeared severe pain, incessant, running down the left arm and neck and radiating to the forearm and the thumb. Movements of hyperextension of the spine were limited, and there was deformity of the vertebral column, particularly accentuated at the level of the fifth and sixth cervical vertebrae, which were flexed anteriorly and sharply curved.

Simple immobilization with apparatus was sufficient to relieve the severe pain, and patient was able to partially resume his occupation.

In such a case, the trauma should not be regarded as the sole causative agent. The field is already prepared, so that even a slight trauma is sufficient to aggravate or to precipitate these lesions. In the presence of arthritis of the vertebral column, the articular trauma may not be recognized unless very severe.

Dr. Edouard Papin discussed the use of osteotomy to give support in old hip disease. When it is desired to add a solid support in cases of coxalgia in which the cure has resulted with only partial ankylosis, indications are in general to produce this support by an arthrodesis, the preference being in favor of the extra-articular arthrodesis according to the method of Mathieu. In certain cases this procedure is not applicable.

The case reported is that of a young man of eighteen who had had a severe coxalgia since the age of five, in which the result was in no way brilliant. The patient was not able to walk, and there was movement of the head of the bone on the pelvis; in addition, there was definite deformity upon abduction and external rotation. It was decided to perform an extra-articular arthrodesis according to Mathieu's technique, but the day before operation there developed signs of a large abscess in the region of the trochanter. Upon puncture and injection with lipoidal, the abscess was found to occupy the entire trochanteric region. After the abscess was healed, x-ray showed that the lesion was too extreme to attempt an extra-articular arthrodesis, but at the same time some form of solid support was indispensable. This support was obtained later by the osteotomy which is used in congenital dislocations, with some slight modification. Abduction of the inferior fragment was much less than for the congenital dislocation, because of much less mobility in this hip than in luxated hips, and it would be unfortunate should the patient be cured with an abduction which then could not be corrected. With particular care in the details of technique in this case, it was possible to obtain a support of the lesser trochanter against the pelvis. The patient showed marked improvement and was able to walk easily with a cane.

These observations should be emphasized,—first, that it is not always possible, in the evolution of the tuberculous process in a diseased hip, to determine without radiographic evidence whether there may be an extra-articular abscess; second, that in cases in which the extra-articular arthrodesis cannot be used, this osteotomy with support may be used to advantage.

A case of Recklinghausen's disease was reported by Gourdon and Pene. There is no definite clinical sign to define Recklinghausen's disease; diagnosis can be established only by x-ray. The case here reported is of a patient of forty-two years, who in June 1927 was seized by severe intercostal pain, which reappeared frequently and obliged the patient to rest in bed during the month of August. After this period, the catamenia entirely disappeared. The diagnosis was not made until the radiograph showed the presence of

light areas in the pelvis. In spite of the treatment directed toward calcification, the decalcification of the bones progressively increased during the next two years, involving the pelvis and the vertebral column, which showed numerous disseminated rounded areas, and also, although less numerous, in the limbs and in the skull. This decalcification was accompanied by a condition of grave anaemia, which finally became fatal.

Although the development of this affection was rapid, the diagnosis of Recklinghausen's disease appeared to be the most accurate for many reasons. The severe anaemia accompanying this form of destruction of the skeleton and the appearance of the rounded decalcification with clearly defined contour was described by Leri as this type of the disease. Moreover, repeated examination of all the organs did not disclose any sign of malignant tumor which would give evidence of a bone metastasis. The cause of this decalcification appeared to be of endocrine origin. This hypothesis is in conjunction with opinions based on clinical experimentation of MacCallum, Vogtlin, Mandlt and Gold. The therapeutic proof, confirmed by the radiograph, has been furnished by Chavé and Verger, who have been able, by means of endocrine and heliotherapy, to develop an affection of the bones of the Recklinghausen type, and also to effect a cure.

Current Literature

FRACTURES AND THEIR COMPLICATIONS. By George Ewart Wilson, M.B., F.R.C.S., F.A.C.S. New York, The Macmillan Company, 1931.

In this work there is an unusually careful and detailed description of the treatment of fractures, and the author has considered practically all the usual and a large number of the unusual varieties. He has given the result of his experience, and has explained how to avoid and how to deal with many of the difficulties which are constantly met and which are unexpected, unless the surgeon is forewarned by a previous and a large experience. The author's own method of handling these cases will help the student and the practitioner to many times avoid those complications which beset the surgeon who has not had an extensive training in this class of cases.

In this book the author has not dealt with the various methods of treatment which are in vogue, so many of which have been frequently described, except in so far as he has employed these methods of treatment, supplemented by his own personal experience. In this way there is given a concise and a single method of treatment of each fracture, and the reader, therefore, is not assailed by doubts as to the choice of means, methods, etc.

For example, in the application of plaster in fractures of the neck of the femur, scarcely any detail, however small but nevertheless important, has been omitted; and in such fractures it is the attention to these details which so frequently determines the success or the failure of the treatment. The same is true in other difficult cases, particularly in fracture of both bones of the forearm. Not only has the author given the explanation of the difficulties, and described the methods of procedure in reduction and in retention of the position during the application of the splint or plaster, but also he has treated with careful detail the operative measures, when such prove necessary.

The author has emphasized the value of the fluoroscope in the reduction and retention of all fractures; but he recognizes that this refinement of equipment is not possible under all conditions in which fractures must be treated, and he has, therefore, given advice for conduct under less favorable circumstances.

The main portion of the work is preceded by a general description of the simple fractures and compound fractures, as well as the pathology and the process of repair. He has also considered the use of physiotherapy and occupational therapy.

CHRONIC ARTHRITIS AND RHEUMATOID AFFECTIONS WITH RECOVERY RECORD. By Bernard Langdon Wyatt, M.D., F.A.C.P. New York, William Wood & Company, 1930.

This interesting little volume from the press of William Wood condenses in small compass the present status of the chronic arthritis problem. The initial emphasis laid upon the importance to the public as well as to the individual of an early recognition of the disease is well shown in the statistics presented by the Metropolitan Life Insurance Company. There are also some interesting figures from the draft for the Great War, showing what percentage of the examined had arthritic lesions and how these figures differed for different parts of the country, the figures being by states.

In the discussion of the classification of the subject there has been shown a commendable disposition to narrow the matter down and bring the nomenclature in as close accord as possible with known pathological facts, admitting that it is not perfect by any means, but practical. The division of the subject is into three classes,—*viz.*, the infectious or proliferative, the degenerative or osteo-arthritic, and the metabolic, which the author restricts to gout. In the chapter on "Early Diagnosis" the author stresses the signi-

ficance of certain early signs, attention to which would enable preventive measures to be started at a time when much disablement might be avoided. The importance of the general practitioner's recognition of these early symptoms is emphasized as well as the entire propriety and feasibility of his handling them throughout their whole course.

Sane and practicable suggestions are made as to the dietetic management of these patients, calling attention to the fact that most American diets are "too rich in calories and too poor in vitamins". Drugs, vaccines, and proteins are put in their proper places as adjuvants in treatment, the author's experience apparently having given him grounds for confidence that both of the later mentioned agents have a specific rôle to play in certain cases.

In the uses of physiotherapeutic agencies he indicates a catholic spirit in pointing out the benefits that may be expected from their employment in particular types of arthritis. The chapter devoted to exercises, joint movements, and massage is exceedingly valuable as it lays down specific instructions applicable to individual joints and calls attention to the value of this feature of treatment, to which too little attention has generally been paid.

The value of a dry climate in a latitude where the sun is of considerable intensity for heat production is well supported by facts, and substitutions therefor are suggested when it is not practicable for patients to visit such localities. A chapter is allotted to the orthopaedic measures that are so frequently called for in the treatment of arthritis, in which they are given their due, but the author points out that most of them would be unnecessary if treatment were commenced earlier.

The book is admirably written, and is well balanced in its presentation of the essentials of diagnosis and treatment, giving due consideration to the contributions that have come from the laboratory sciences. It is decidedly the best presentation of the subject that has thus far been made, from the practical standpoint of treatment.

CANCER, ITS ORIGIN, ITS DEVELOPMENT AND ITS SELF-PERPETUATION. By Willey Meyer, M.D. New York, Paul B. Hoeber, Inc., 1931.

A theory of the cause and development of cancer is presented, based on an extensive study of the literature. There must be a predisposition on the part of an individual if he is to develop cancer, but not all with such a predisposition do develop the disease. This predisposition lies in the unbalanced state of the blood serum, and in a crowding of cells. Chronic irritation of some sort is responsible for the precancerous condition in a focus where there is death of cells. The products of decomposition of these cells or "necrones" increase the normal multiplication of cells at this point with the slogan "Die or divide". The author believes that the cancer thus formed is a passive growth of cells, the growth taking place at the original focus and forcing the older cells outward and onward into other tissues without active invasion. The degree of growth of the cells depends on the degree of concentration of the necrones in solution in the tissues around the focus. Cancer begins when the older cells of the tumor begin to undergo necrobiosis and furnish a greater concentration of the "necrone" solution, which in turn hastens the growth of the cells.

The therapy of precancerous conditions lies in destroying or removing the focus before there has been a concentration of "necrones". In other instances the therapy must be directed toward a more rapid and certain healing of injured tissues.

References to the literature are cited which show that the predisposition to cancer lies in an alkalosis, an overbalance in the serum of sodium and potassium over calcium. It is stated that the pH of cancer patients is always on the alkalosis side. Therapy lies, then, in reducing the alkalosis or producing an acidosis. The administration of calcium in small doses is suggested for all with a family background of cancer, for all with suspected lesions, or for those with a blood serum more alkaline than normal. The author would not discard present methods of cancer therapy, but he would supplement their treatment with calcium medication and he would so treat the inoperable patients and those refusing surgery or radiation.

Unfortunately, "how to administer calcium effectively has still to be learned". At present the most effective drug is calcium lactate in a five per cent. watery solution. Ammonium chloride is also stated to be effective in producing acidosis.

The book as a whole is most interesting. It shows a most painstaking review of the cancer and experimental literature of a century. The quotations are so numerous that it is a bit difficult to separate the ideas and conclusions of the author from those of his contemporaries. Many of his theories seem to be well based on experimental data, but occasionally there does not seem sufficient ground for drawing his conclusions.

The disappointing part of the book is the lack of clinical or experimental data to show that changing an alkalotic patient to an acidotic one has any effect on the disease. Let somebody go on from here and see if the theory works.

A Treatise on Orthopaedic Surgery. Ed. 9. By Royal Whitman, M.D., M.R.C.S., F.A.C.S. Philadelphia, Lea & Febiger, 1930. $10.00.

The demand for the ninth edition of Dr. Whitman's Orthopaedic Surgery is indicative of the value of this book and the appreciation of the medical public of the author's presentation of the subject. As in other editions, the author has emphasized the basic principles of the mechanical disability associated with orthopaedic surgery, and the necessity of keeping in mind the importance of the functional standpoint in the treatment of these affections. The subjects are treated simply, so that the student and the general surgeon may be guided in the general diagnosis and in the determination of treatment of those affections which are likely to come under their observation and care. The experienced orthopaedic surgeon must necessarily turn to more elaborate and specialized studies of individual subjects. Dr. Whitman's large experience in tuberculous disease renders his opinion in this group particularly valuable at this period, and it is satisfying to see that the experience gained in the earlier days, when tuberculous disease constituted the larger part of orthopaedic surgery, does not give way to the modern radicalism, except in so far as to be judiciously tempered by it. Dr. Whitman has always been in the lead in the study and development of the non-tuberculous adult orthopaedic affections. He has added in this volume the recent developments, with reference to the diagnosis, pathology, and treatment of these conditions, and in discussing the treatment there is seen the result of his large operative experience. The book is very complete in the scope of subjects, and treats practically every condition that can properly be classed in this specialty.

If the reader finds overemphasis in the presentation of some of the subjects, he will realize that he is getting the clear and definite opinion of the author, whose positive standpoint is one of the elements of the teacher whose aim is that of precision. This is a need, both to the student and to the general practitioner who uses a treatise covering the whole of a department of surgery. If one starts with a clear conception of a surgical condition and a method of treatment, he can modify either with his increasing experience.

The final chapter on "Collateral Orthopaedic Surgery", which originally appeared under the title of "Military Orthopaedics", is interesting from a historical point of view indicating the special needs at that time of emergency, when it was necessary to define,—and yet not too closely—the lines separating the different departments of surgery. One should not, however, even with considerable elaboration, take the view that the division made at that time of emergency should hold at this late date and in practice in civil life, or that it should serve today in the field of industrial surgery, which has made such remarkable advances in the last decade.

Modern Surgery. Ed. 10. By John Chalmers DaCosta, M.D., LL.D., F.A.C.S. Philadelphia, W. B. Saunders Company, 1931. $10.00.

In presenting the tenth edition of this popular work, the author acknowledges the difficulty of revision in a book of this kind, because from the wealth of new material which is constantly being added to the knowledge of each subject it is necessary to choose,

and it is often difficult to draw the line between what to accept of the new and what to discard of the old traditions which have perhaps outlived their time. Because of advances made in some departments,—for instance, in x-ray—it is necessary to present these parts almost as a separate portion or in a separate treatise.

The reader is impressed with the completeness and the scope of this work, for it comprises not only the vast number of surgical affections which come under the title of this book, but also treats in accurate detail, for a textbook, the pathology as well as the physiological processes of repair which are connected with these affections. Especially it is valuable for the student, and for the practitioner who is obliged in these times to keep conversant with so large a number of subjects and be ready to deal with them.

The author has given the essential details of operative technique in the surgical treatment of the various conditions. These are practical, and will be helpful to those who are not particularly familiar with all the various methods and, therefore, need instruction and guidance in the choice of these methods of surgical procedure. The résumé of these procedures is of value even to those who are accustomed to a wide field of surgery.

This book is particularly complete because of the consideration of all subjects which could be grouped in the surgical department of medicine and surgery; and the careful detail in the recognized essentials of each subject, as well as the careful selection of the new material which is used, adds value and increases the recognized position which this book has always had in the profession. The classification of subjects into groups facilitates the efforts of the reader to find quickly the special subject desired.

PYE'S SURGICAL HANDICRAFT. Ed. 10. Edited by H. W. Carson, F.R.C.S. New York, William Wood & Company, 1931. $7.00.

This book was originally written for the special use of the student, the intern, and the general practitioner, to give information on the practical technique, particularly of the every-day simple surgical tasks, and it has held a special place in the medical world since its first appearance. Few books have been written which have responded to the need of so large a group of the young practitioners as does this book of Mr. Pye's Surgical Handicraft, for it supplies what frequently is lacking in the early education, both in schools and in hospitals, to the man who must depend upon himself in the treatment of so many of the minor as well as the more severe surgical affections.

The book is more than the title implies, for the various surgical conditions for which the apparatus, technique, etc., are described are sufficiently explained to make clear their use and practical application. One is impressed with the complete scope of the subjects collected in this volume, for the reader will find practically every surgical condition treated, with the new information on the subject, and very complete description of the handicraft methods and means of treatment. With the collaboration of men eminent in their special fields, new chapters have been added on venereal diseases, radium treatment of cancer, infected wounds of the hand, injection treatment of varicose veins, tannic-acid treatment of burns, skin grafting, etc. The chapter on anaesthesia contains information as to the new methods and drugs.

This revision brings this edition into line with modern learning and practice. In this tenth edition, like many of the previous editions, the revision has passed through the hands of Mr. Carson, who has always adhered to the original plan of Mr. Pye.

LOVETT'S LATERAL CURVATURE OF THE SPINE AND ROUND SHOULDERS. Ed. 5. Revised and edited by Frank R. Ober, M.D., and A. H. Brewster, M.D. Philadelphia, P. Blakiston's Son and Co., Inc., 1931.

Some medical books, because of their intrinsic merit, appear in edition after edition. This is such a book. The thoroughness of research and the completeness of presentation by Dr. Lovett made the original output so unique as to require but little change in subsequent editions in any but the chapters on "Treatment". Indeed, much of this also stands today as Lovett presented it.

In this fifth edition, Ober and Brewster, who were fellow-workers with Lovett, add to the treatment that which is necessary to meet changing opinions of the profession. Thus, Galeazzi's method of applying corrective plaster-of-Paris jackets, by the use of an elaborate apparatus which forces derotation and which involves the building of the jacket in segments, is described, although not so clearly as the reader could desire. Also Lovett's uses of the turnbuckle screw corrective jacket and of the turnbuckle shell are given in detail. Various methods of operative fusion of the scoliotic spine, in use today, are discussed by the editors. The limitations of this procedure are set forth. The chapter on "Exercise" is practically rewritten and clarified. Perhaps most valuable of all is the able discussion of the relative merits and the combined use of the various means of treating scoliosis now at our disposal. The single chapter on "Faulty Posture and Round Shoulders" is unchanged in this edition.

The book throughout is well illustrated, some valuable new pictures having been added. A thoroughly good textbook has been ably brought up to date.

IMMUNO-CHIRURGIE. By Gaston Daniel. Paris, N. Maloine, 1931.

This author has used the term "immunotherapy" to unite in the same definition the serum and the vaccine therapy, and takes up briefly the various kinds of both agents. He first considers the divers forms of serums and vaccines, and then treats of their use in each form of infection. The preventative use of vaccine therapy is given a full share of attention, and its method of use, as well as the detailed directions for its application, are treated in their proper place in the book.

The author is naturally quite enthusiastic about serotherapy and vaccinotherapy, but he makes no undue claims as to the efficiency of these methods in bone and joint infections but clearly defines the limitations. On the other hand he feels that with the success in some serum and vaccine therapy,—for instance, its use in tetany—and also the improved laboratory technique, we may look forward to more favorable results in the future.

Except for osteitis and osteomyelitis, this book deals little with those subjects which can be grouped under the term "Orthopaedic Surgery". The chapters devoted to these subjects are short and not conclusive, even that on gonorrhoeal arthritis.

The Journal wishes to acknowledge the receipt of the following publications sent to the Editorial Department:

*Traumatotherapy. By John J. Moorhead. Philadelphia, W. B. Saunders Company, 1931.

Boletin de la Sociedad de Cirugia de Chile. Santiago, Vol. VIII, No. 12, October 1930.

Giornale Medico dell' Ospedale Civile di Venezia. Venezia, Vol. IV, Nos. 5 and 6, October and December, 1930.

Medicina del Trabajo e Higiene Industrial. Madrid, Vol. I, No. 6, November 1930.

Slovanský Sborník Ortopedický. Brno, Czecho-Slovakia, Vol. V, Nos. 5 and 6, 1930.

Norsk Magasin for Laegevidenskapen. Oslo, Vol. XCII, Nos. 1, 2 and 3, January, February, and March, 1931.

Bulletin of the National Tuberculosis Association. New York, Vol. XVII, Nos. 1, 2 and 3, January, February, and March, 1931.

Fortidlig Födte Barns Prognose og Födselstraumets Profylakse. By Anton Sunde. Norsk Magasin for Laegevidenskapen. Vol. XCI, November 1930.

Warum entsteht bei Druckusur der Wirbelsäule durch Aortenaneurysma kein Gibbus, *and* Zur Behandlung der Radiusfraktur. By A. Schanz. Archiv für Orthopädische und Unfall-Chirurgie. Berlin, Vol. XXVIII, Nos. 2 and 3, 1930.

*To be reviewed in a later issue of *The Journal*.

Hilfstragorgane der Wirbelsäule. By A. Schanz. Archiv für klinische Chirurgie. Berlin, Vol. CLIX, No. 3, 1930.

Simulation?—Neurose?—Insufficientia vertebrae traumatica? Ein Gutachten, dem Reichsversicherungsamt erstattet. By A. Schanz. Acta Chirurgica Scandinavica. Stockholm, Vol. LXVII, No. 1—6, 1930.

Capital Investment in Hospitals. By C. Rufus Rorem. The Public's Investment in Hospitals. The Committee on the Costs of Medical Care, Washington, D. C. 1930.

EIN OPERIERTER FALL VON (An Operated Case of) TENDINITIS CALCIFICANS TROCHANTERICA. Harald Nilsonne. *Acta Orthop. Scandinavica*, I, 231, 1930.

One year after a fall on the right hip, a forty-seven-year-old woman developed pain in the hip with radiation to the right knee and tenderness over the greater trochanter. A bean-sized calcific shadow was seen on x-ray just lateral to the tip of the trochanter. It proved to be a calcium deposit in the gluteus medius. Its removal relieved the symptoms completely.—*W. P. Blount, M.D., Milwaukee, Wis.*

HALLUX RIGIDUS AND ITS TREATMENT. Harald Nilsonne. *Acta Orthop. Scandinavica*, I, 295, 1930.

Primary hallux rigidus usually develops at the age of twelve to fifteen, with stiffness of the basilar joint of the great toe, capsular swelling, exostoses, and finally inability to dorsiflex. Abnormal length of the first metatarsal is a frequent finding and is probably etiologically related to this deformity as to hallux valgus. The designation of a plus or minus metatarsal index is suggested according to whether the first metatarsal is longer or shorter than the second. Among 497 normal feet the index was plus in thirty-four per cent. In 121 cases of hallux valgus and forty-nine cases of hallux rigidus the percentage of plus indices was eighty-eight and eighty-one respectively. Treatment consists of the use of foot plates with elevations under the first metatarsal heads, or arthroplasty in the severe cases.—*W. P. Blount, M.D., Milwaukee, Wis.*

MYOPLASTY ON THE GLUTEUS MAXIMUS IN PARESIS OF THE ABDUCTORS OF THE HIP JOINT. P. G. K. Bentzon, *Acta Orthop. Scandinavica*, I, 310, 1930.

In 235 cases of poliomyelitis analyzed, thirty-six had no or slight impairment of the gluteus maximus with paralyzed or very weak abductors. In two cases the insertion of the upper half of the gluteus maximus was transferred to the greater trochanter to act as an abductor. Improvement of the abductor limp was obtained, but one case was operated upon sixteen months after the acute attack.—*W. P. Blount, M.D., Milwaukee, Wis.*

OSTEOCHONDRITIS DISSECANS (KÖNIG) FROM A ROENTGENOLOGICAL VIEWPOINT. Gösta Jansson. *Acta Radiol.*, XI, 33, 1930.

On a basis of clinical experience and comparative roentgenological studies of the removed joint bodies and the depressions in the articular surfaces of joints, the author believes that osteochondritis dissecans is a unique syndrome. He favors Axhausen's embolization theory in regard to mechanogenesis.

The process would appear to be the following: A certain portion of the articular surface of the femur becomes necrotic. The shape of the portion suggests an infarct. The bone beneath the cartilage undergoes necrosis in irregular fashion, the cartilage remaining viable for a long time. In this infarct some portions remain solid while others are absorbed. In time a nest is formed containing often several free bodies. As the result of a trauma, the cartilage which has been hitherto intact now gives way and several "joint mice" may be spilled into the joint cavity. The cavity of this sequestrum as a rule heals with granulation tissue.—*Joseph Milgram, M.D., Iowa City, Iowa.*

ISOLATED ASEPTIC NECROSIS IN THE EPIPHYSIS OF THE FIRST METATARSAL BONE. Aage Wagner. *Acta. Radiol.*, XI, 80, 1930.

Since Osgood and Schlatter described the so called aseptic necrosis of the tibial tuberosity which bears their names, a great many other growing bones have been observed to undergo similar transformations. The author adds the epiphysis of the first metatarsal bone of the left foot of a child of six years. Narrowing of the epiphysis and sclerosis, associated with pain and swelling of the foot, afebrile and atraumatic, constituted the pathological entity. No histological findings were obtainable.—*Joseph Milgram, M.D., Iowa City, Iowa.*

MYELOMATOSIS IN A CHILD OF EIGHT YEARS. Paul Jacoby. *Acta. Radiol.*, XI, 224, 1930.

An eight-year-old female child for six months had had difficulty in holding her back erect. A diagnosis of spondylitis was made. The x-ray revealed an affection of the bodies of all of the vertebrae, most marked in the lumbar spine. Most of the bodies were biconcave; all were considerably flattened; all were much lacking in calcium, almost structure-free. After nine months' hospitalization during which the patient gradually grew more weak and anaemic, and during which abrupt periods of fever appeared, the patient died. At postmortem the bodies of all the vertebrae were found to consist of a paper-thin cortical layer, filled with soft red myeloma. The intervertebral spaces had enlarged at the expense of the softened bodies. Roentgenograms of the spine before and after death and removal are appended.

Very few cases of myelomatosis in children are recorded.—*Joseph Milgram, M.D., Iowa City, Iowa.*

CONCERNING IDIOPATHIC OSTEOPSATHYROSIS. Leon Prussak and Natan Mesz. *Acta. Radiol.*, XI, 175, 1930.

In a review of the German and French contributions to the literature, Lobstein is credited as the originator of the name over a century ago. He considered it as well the outstanding symptom of a number of other diseases, such as rickets and scurvy. He described the basic picture quite accurately. It was not until 1891 that Ammon added the second factor to the picture,—blue sclerae. The third symptom,—deafness in later life—was added by Van der Hoeve. Today we therefore emphasize the triad,—brittle bones, blue sclerae, and (otosclerotic presumably) deafness. The familial trait has been much emphasized in the cases reported. Sporadic cases, however, have also been frequently observed. X-ray pictures of such bones reveal a thinned calcium-poor cortex and a widened marrow cavity, crossed by delicate bony spicules. Fractures, and especially infractions, heal well and may be difficult to demonstrate later. Spontaneous fractures through muscle pull are recorded. Some patients have had over a hundred fractures. Fractures appear to decrease in frequency with advancing years and are rare after the age of twenty-six years. There have been recorded, however, cases in which the first symptoms appeared in advanced age. Characteristic skull deformities have been observed. Relaxation of ligaments appears to be common. The cause for the blue sclera is attributed to the abnormal thinness and calcium poorness of these tissues, permitting the deeper structures to shine through. Changes in the electrical reactions of the muscles have been recorded by a few. Brittleness of hair, nails, and teeth, pigment changes in the skin, associated with disturbances of the endocrine glands, have been observed.

The authors describe three cases of idiopathic osteopsathyrosis. Case I: A girl of twelve years had brittle bones and blue sclerae; six other members of the family had blue sclerae but there were no fractures. Case II similarly presented no hereditary characteristics. In both cases the osseous changes characteristic of idiopathic osteopsathyrosis,—abnormally thin cortex and reduced calcium content—were distinct. Case III: The affection was accompanied by a chronic obscure brain disorder, associated with epileptic seizures and imbecility.—*Joseph Milgram, M.D., Iowa City, Iowa.*

THE EFFECT OF PHOSPHORUS IN RICKETS. Edward L. Compere. *Am. J. Dis. Child.*, XL, 941, November 1930.

The author discusses clinical and laboratory experiments of phosphorus administration. He states that the bones of patients who die of chronic phosphorus poisoning are often hardened and enlarged while the bones of those of more acute poisoning show softening and necrosis. The author discusses a series of ten cases of severe infantile rickets and one case without rickets. In two cases cod-liver oil alone was used, and in three cases phosphorus alone was used. In two cases the effect of the administration of phosphorus with oil added later, and in three cases the effect of phosphorus and cod-liver oil, was studied.

He concluded that phosphorus alone was not sufficient medication to bring about healing in severe cases of infantile rickets. Cod-liver oil alone, administered to infants with severe rickets in dosage of three to six teaspoonfuls daily, brought about healing in most of the cases. Cod-liver oil in combination with phosphorus produced a more prompt and more certain healing of rickets than did cod-liver oil alone.—*T. H. Vinke, M.D., Iowa City, Iowa.*

THE SYMPHYSIS PUBIS IN THE ROENTGEN EXAMINATION OF THE SACRO-ILIAC JOINT. W. Edward Chamberlain. *Am. J. Roentgenol.*, XXIV, 631, December 1930.

This is a very interesting and instructive paper, and is written to show that the existence of sacro-iliac displacements can be shown by making stereoscopic studies of the pubic bones. One picture is made with patient's right foot resting on a block three inches high and the left foot hanging; another is made with the left foot resting on the block. An anterior projection of the symphysis is then obtained. The author does not claim to have proved that the "so called slip" is the primary factor in acute low back trouble. In his experience the patient's acute symptoms have almost always been found on the side of the high pubis.—*Edward S. Hatch, M.D., New Orleans, La.*

THE ROENTGEN TREATMENT OF METASTASIS TO THE VERTEBRAE AND THE BONES OF THE PELVIS FROM CARCINOMA OF THE BREAST. Eugene T. Leddy. *Am. J. Roentgenol.*, XXIV, 657, December 1930.

The value of roentgen therapy for skeletal metastasis is difficult to determine, but the general opinion seems to be that treatment in the advanced stage for metastatic carcinoma is useless; some, however, have described brilliant results. There is also a controversy as to the mechanism by which malignant cells are carried to the vertebra. The characteristic secondary symptom is pain, which may be slight or very definite; motions of the spinal column intensify the pain, while rest relieves it. The early stages may last a long time without palpable deformity of the bone. Treatment is palliative only,—sedatives, nursing, and jackets rarely give complete relief from pain. "Treatment by roentgen rays, by an effect on both the inflammatory and malignant cells in the metastatic growths, produces analgesia, often complete and of months' duration, and is the best method of palliating a hopeless disease."—*Edward S. Hatch, M.D., New Orleans, La.*

SOME OBSERVATIONS IN CALCIUM FIXATION. E. J. Berkheiser. *Am. J. Surg.*, X, 294, November 1930.

Calcium privation seems to be due to faulty assimilation rather than to dietary deficiencies, and the use of a mineral salt combination with phosphorus is advocated by the author. Several cases of faulty and delayed union are described, with good bony union in all cases following the use of the formula, one case having bony union after four and one-half years of non-union. Further study and a larger series of cases would prove interesting.—*Custis Lee Hall, M.D., Washington, D. C.*

OPERATIVE ARTHRODESIS OF THE SPINE: A CONSIDERATION OF THE EMBRYOLOGICAL AND MECHANICAL FACTORS INVOLVED. D. M. Gratz. *Am. J. Surg.*, X, 341, November 1930.

The author states that the development of the posterior portion of the spine is primarily from the ectoderm, while peripheral bone is from the mesoderm, and that most of our knowledge of bone repair is from studies of the latter group. We have very meager knowledge of osseus repair in bone of ectodermic origin. Such data gained from postmortem and x-ray studies show the poor repair in fractures of the spine, including the spinous processes and laminae. This is in line with the theory of Leriche. Conclusions are that the osteoplastic fusion is more successful in the young, and confined to the cervical and dorsal spine, while the inlay graft is more suitable for the lumbar spine. —*Custis Lee Hall, M.D., Washington, D. C.*

BEITRAG ZUR KLINIK, MORPHOLOGIE UND ÄTIOLOGIE DER OSTITIS TUBERCULOSA MULTIPLEX CYSTOIDES. F. Schürer-Waldheim. *Arch. f. klin. Chir.*, CLX, 680, 1930.

This disease was first described by Jüngling in 1920. Further contributions were made by Fleischner, who called attention to the combination of bony changes, especially to those of hands and feet, with skin diseases such as lupus or miliary lipoid. A case of this type is described by the author. The patient, a man of thirty-five, complained of rheumatic pain and increasing swelling and redness of the fingers, which became ulcerated. The disease progressed slowly without febrile reaction. The x-ray pictures showed a progressive destruction of bone tissue, especially of the toes and fingers, with extension to the soft parts; later, this came to perforation and the establishment of ulcers.

Two principal types are distinguished,—one diffuse, and one more circumscript. The case reported by the author is of the latter type. The x-ray picture shows multiple punched-out areas. Areas of bone apposition can be seen, side by side, with these destructive changes. Guinea-pig inoculation from material recovered remained up to the time of the report (eight weeks) negative. The pathogenesis of this disease is explained on the grounds that the bacilli have lost their lipoid cover and died, or may be still present in younger foci. The histological examination of the case of the author shows grossly great similarity with the picture of lupus. There were bundles and accumulation of epithelioid cells between lymphocytes and leucocytes. The number of cells was much smaller but the structure corresponded very much with that seen in lupus. The bone tissue shows osteoblastic activity in places, lacunar absorption of the spongiosa trabeculae with osteoblast lines between. There is no sign of caseation. Classical tubercles with typical central location of giant cells were not found in the case of the author. A lupus pernio of the nose and of the nostrils was noted at admission. The connection between these lupus pernio to that of the tuberculosis multiplex cystitis is emphasized. It is proven to be tuberculous and it is assumed that the osteitis multiplex is of the same etiology.—*A. Steindler, M.D., Iowa City, Iowa.*

MOBILIZATION OF ANKYLOTIC ELBOW AND KNEE JOINT BY ARTHROPLASTY. J. Hass. *Arch. f. klin. Chir.*, CLX, 693, 1930.

The principal departure of the author's method from the usual technique lies in the simplification and reduction of the joint constituents. Already Payrs considers the idea of minimizing the areas of contact in immobilization of joint by forming the joint end in the shape of wedges. During the War Spitzy likewise endeavored to create more simple mechanical conditions by tapering off the distal end of the humerus into a narrow wedge which is made to glide in a shallow trough made by the ulna. Already, in 1925, the author has pointed out that it would be more rational to renounce the rude anatomical reconstruction of the original form of the articular body by simply leaving the functional transformation of the joint to the effort of late postoperative changes. And with this in mind, the author forms the joint of the elbow and knee in such a fashion that the con-

cave body is made to a flat and shallow transverse trough with the convex joint body which transforms into a wedge.

Klapp, in his plasty of the knee joint, leaves entirely the posterior portions of the condyles of the femur since they are not likely to obstruct the flexion range. The author mentions the endeavors of Kofmann, of Odessa, who produced a pseudarthrosis of the jaw in ankylosis by resecting a piece of the ramus and shaping the end as a point articulating in the glenoid cavity.

The method of Hass has the advantage of simplicity as well as of accuracy. Nothing is taken from the length of the bone and the insertion of the lateral ligament is spared, a factor which is of especial importance for the mechanics and statics of the knee joint. The after-treatment also is simplified, and one need not resort to permanent extension treatment; two weeks after the operation active motion may be started. For the first two weeks the leg or arm is placed in a plaster bandage in position of extension. The author has operated by this method in fourteen cases of ankylosis of the elbow and five cases of ankylosis of the knee. Of seven elbow plasties reexamined later, five gave an excellent result, whereas two cases re-ankylosed. Of four plasties of the knee joint, three gave an excellent result,—that is, they had range of motion to right angle and a complete active extension, stability, and good alignment; the fourth case had a very good initial result, but a deformity developed two years later, after a fracture of the thigh.

The author draws his field of indication rather narrow, excluding absolutely tuberculous ankylosis. He is also very hesitant about ankylosis in osteomyelitis, his two bad results being cases of this type. The best results are obtained in gonorrhoeal ankylosis and in complete ankylosis after pyemic infections. He gives the technique of the arthroplasty of the elbow and of the knee joint. All in all, very good results were obtained in seventy-five per cent. of the cases. Postoperative painful arthritis was never observed. —*A. Steindler, M.D., Iowa City, Iowa.*

POLIOMYELITIS. Henry Heiman and Philip Cohen. *Arch. Pediatrics*, XLVII, 537, September 1930.

The authors define and give history, bacteriology, etiology, and epidemology of poliomyelitis. They classify the disease into:

1. Non-paralytic cases which compose eighty to ninety per cent. of the total.
2. Paralytic cases which compose ten to twenty per cent. of the total.

In the human, the disease affects all parts of the body primarily and the nervous system secondarily. The changes in the spinal cord are most marked where the cord is most vascular,—namely, in the cervical and lumbar enlargements. The pathological changes in the nervous system are as follows:

1. Temporary meningitis due to mononuclear infiltration (this is not a necessary feature).
2. Oedema with destruction of anterior horn cells which are poisoned by the toxin and strangled by oedema.
3. General perivascular round-cell infiltration.
4. Punctate hemorrhage, with rupture of the pial vessels.
5. Shrinkage and lysis of anterior horn cells which become invaded by polymorphonuclear leucocytes.
6. Sclerosis in the late cases.

The symptoms are discussed and three types of cases are recognized:

1. The abortive type which subsides without involving the nervous system.
2. The dromedary type in which there is a return to normal for a few days following the general systemic invasion and then an exacerbation with symptoms indicative of meningeal involvement followed swiftly by paralysis.
3. The acute type in which the nervous system becomes involved while the general infection is at its acute stage.

Treatment is discussed, and the use of convalescent serum encouraged for both prophylaxis and treatment.—*T. H. Vinke, M.D., Iowa City, Iowa.*

THE PATHOLOGY OF CONGENITAL TORTICOLLIS. D. S. Middleton. *British J. Surg.*, XVIII, 188, October 1930.

The older theories of the etiology of this condition are discussed and criticized. The author does not believe that it is due to a hematoma following a rupture of the muscle during labor, for the usual signs of hematoma are not present. The ischaemic theory comes closest to his conception of the condition. He describes the sternomastoid tumor occurring one or two weeks after birth and mentions the typical "cartilaginous" sensation to the tumor. Microscopically, it consists of young fibrous tissue with remnants of muscle fibers. He believes that torticollis is a late stage of sternomastoid tumor which does not show up until the child develops a longer neck, and thus calls into play the sternomastoid muscles.

Experimentally, he has ligated the venous return from the sartorius muscle, leaving the arteries and nerves intact. The muscle becomes cyanotic, swollen, and on microscopic examination a few days later, the muscle fibers are undergoing degeneration. Eight weeks later the muscle has been converted into a solid fibrous mass having the same appearance as the sternomastoid tumor from a child six weeks after birth.

He believes that the venous return from a portion of the muscle has been obstructed during labor. He points out that the muscle receives its blood from three sources with three sets of veins. Any one of these may be obstructed during labor. He calls attention to the frequent occurrence of an exostosis at the clavicular attachment of the sternomastoid muscle. He believes this is due to the increased trauma by the short muscle, and points out that the accompanying changes in the skull from a torticollis of ong standing is a true scoliosis capitis.

THE INTERVERTEBRAL DISCS. N. Ross Smith. *British J. Surg.*, XVIII, 358, January 1931.

The author has made an extensive study of the intervertebral discs, their embryology, physiology, and pathology. "The discs are rudimentary, diarthrodial joints, possessing a cavity filled with villae a fibrocartilaginous capsule, and upper and lower cartilaginous plates comparable to articular cartilages. The mode of nutrition of the discs is by blood channels which pierce the cartilaginous plates from the marrow of the vertebral bodies." Fifty-seven skeletons have been studied, the ages varying from one to eighty-six years. In the first twenty years the disc is biconvex and highly elastic and the cartilaginous plates are thin. Subsequently the disc becomes more coarse, inelastic, and tough. Various lesions of the discs were found showing fibrous, cartilaginous, calcareous, bony, fatty, necrotic, and liquefactive changes. By x-ray, occasionally a disc is found to be completely calcified. No pathological changes were found during the first two decades. Some skeletons showed juvenile conditions throughout life.

ACUTE OSTEOMYELITIS OF THE SPINE. H. W. Carson. *British J. Surg.*, XVIII, 400, January 1931.

Four cases of acute osteomyelitis of the spine are cited. Three followed a simple boil and cultures from all showed staphylococcus aureus. The author states that the lumbar spine is the most often affected. He reviews the usual symptomatology, methods of diagnosis, and prognosis in this disease. All four of his patients recovered.

OBSERVATIONS ON THE TREATMENT OF CONGENITAL DISLOCATION OF HIP. H. P. H. Galloway. *British Med. J.*, II, 409, September 13, 1930.

Galloway's paper opened the discussion on this subject at the meeting of the British Medical Association in Winnipeg. He presented in convincing style the arguments for open reduction as the best form of treatment for this deformity. He cited the following objections to the manipulative reduction: (1) It is not a "bloodless" operation; (2) In a definite proportion of cases, damage to important structures results from the force of manipulation; (3) There is a high proportion of damaged and distorted femoral heads

after manipulative reduction; (4) The length of the after-treatment is much longer than after open reduction; (5) Finally and most important, the constriction in the capsule is a mechanical bar to reduction which can only be disposed of satisfactorily by incision.

Ideally, he stated, the open operation should be performed on patients from two to two and one-half years of age who have never had any attempt at manipulative reduction performed upon them. The operation must be carried out with the strictest aseptic precautions. He discussed briefly the desirability of earlier diagnosis and earlier treatment of the condition. He discussed also measures for the improvement of older patients suffering from the deformity. The paper was discussed by Laming Evans, Watson Jones, Hartley Martin, W. A. Cochrane, W. E. Gallie, and Melvin Henderson. All these speakers favored manipulative rather than open reduction. The final conclusion of the discussion appeared to be that while the original manipulative method of Lorenz leaves much to be desired in the way of results, modern manipulative methods are very different and very much superior.—*R. I. Harris, M. B., Toronto, Canada.*

Fractures of the Articular Surfaces of the Knee Joint. Robert Ollerenshaw. *British Med. J.*, II, 466, September 20, 1930.

Ollerenshaw discusses briefly the problems associated with fractures involving the articular surfaces of the knee. In his experience their incidence is twenty per cent. of all fractures. He subdivides them into the following groups: fractures of the femoral condyles, osteochondritis dissecans, tibial fractures. Each case presents an individual problem in treatment but generally speaking he has found manipulative reduction under anaesthesia followed by fixation in plaster for six weeks the most suitable treatment. Open operation is reserved for cases resisting manipulative reduction.—*R. I. Harris, M. B., Toronto, Canada.*

The Clinical Aspect of Disturbances of the Parathyroid Gland. J. C. Meakins. *British Med. J.*, II, 856, November 22, 1930.

The function of the parathyroids is the maintenance of the calcium content of the blood plasma at a definite level and the control of the calcium balance of the body. They also regulate the calcium metabolism of the fixed tissues, particularly the osseous system.

Findings are given in tabular form. Parathyroid tetany is discussed briefly. The author then considers the relationship of parathyroid tumors to diseases of bone. He describes the clinical syndrome of hyperparathyroidism. This condition occurs twice as commonly in women as in men, and generally between the ages of thirty and fifty-five. The patients complain of pain in the bones, and spontaneous fractures are common. Hypotonicity of the muscles is sometimes present, and radiograms show a greatly diminished density of the bone shadows, at times with evidence of cystic formation. There is an increased serum calcium, varying from thirteen to twenty-three milligrams per 100 cubic centimeters, a reduction in the plasma phosphorus to between one and two and seven-tenths milligrams, and in all cases there is an increase of the calcium output, which may vary from a moderate degree to eight times the normal figure. This seems to be the opposite to parathyroid tetany, except that there is the additional anatomic finding of pronounced bone destruction.

Nephrosis is next briefly considered, and the effect of parathyroid hormone administration discussed.—*M. E. Pusitz, M.D., Iowa City, Iowa.*

Fracture of the Neck of the Femur. John C. Wilson. *California and West. Med.*, XXXIII, 707, October 1930.

This paper is based on eighty-six cases treated at the Los Angeles General Hospital. Sixty-two of these were treated by the Whitman method of abduction and plaster cast, three by weight extension, two by mobilization and massage (Championier) and fifteen received no treatment.

Of the cases treated by the Whitman method, one patient was between twenty and thirty years old and obtained bony union; two were between thirty and forty, both with bony union; two between forty and fifty, one of whom had bony union. Between fifty and sixty there was bony union in but two, and in seven there was no union of any kind. Between sixty and seventy, eight patients obtained bony union, three fibrous union, ten no union. There were eleven patients over seventy, not one of whom obtained any kind of union. Three patients treated by extension showed bony union in one, no union in two. Both the patients treated by the Championier method failed to obtain union. Of the fifteen patients untreated, only two survived, but they got no union. The mortality was as follows: between fifty and sixty, three patients out of sixteen died; between sixty and seventy, nine out of thirty-two; between seventy and eighty, thirteen out of twenty-four; over eighty, all died.—*William Arthur Clark, M.D., Pasadena, Calif.*

Compression Fracture of the Fifth Lumbar Vertebra. S. N. Jacobs and Lawrence M. Trauner. *California and West. Med.*, XXXIII, 812, November 1930.

Mentioned prominently is the rarity of compression fracture of the body of the fifth lumbar vertebra, uncomplicated by dislocation or compression of other vertebrae, seventy to eighty per cent. of vertebral fractures occurring in the twelfth dorsal and first lumbar. The author further states that the only individual vertebrae not involved were the first, second, and sixth cervical, and first dorsal. The case reported was a compression fracture of the body of the fifth lumbar vertebra, caused by a fall from a ladder, landing on the back. Diagnosis was difficult because of the moth-eaten appearance simulating malignancy. A bone fusion operation was performed; double tibial grafts laid from the third lumbar vertebra to the sacrum, followed by a body cast. One year later the patient was back at work. The last x-ray examination revealed recalification of the body of the vertebra.—*W. R. Hamsa, M.D., Iowa City, Iowa.*

Technique and Experiences in CO_2 Inflation of the Knee Joint. B. Ulrichs. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, XLII, 53, 1930.

The author attributes the inception of this method to Werndorf and Rohmsohn, who in 1905 introduced commercially prepared carbon dioxid from a Wulf flask. Wollenberg later introduced modifications in which he emphasized the use of chemically pure carbon dioxid, limitation of the amount injected, and introduction of the material with observation of the maximum pressure utilized. The gas is prepared in the apparatus, measured by a monometer, and is very slowly introduced into the joint at a pressure of one-half to one-quarter of an atmosphere. A normal adult knee admits 100 to 200 cubic centimeters; an arthritic may permit fifty. Occasionally pain is experienced. The author has employed the procedure 200 times without any other complication but emphysema of the soft tissues and muscles of the thigh. Hoffa is said to have reported a fatal case of gas embolism, but the author cannot verify this in the literature. He does not remove the gas. He advises one to two days' rest in bed thereafter. In his opinion, this method adds very considerably to the ease of diagnosis of internal derangements of the knee. He quotes, in contrast, Bircher, who has injected fifty cases and feels the procedure is not worth the trouble.—*Joseph Milgram, M.D., Iowa City, Iowa.*

Growth of Bone and Development of Rickets. Relative Significance of Certain Associated Factors. Edward Clay Mitchell, and Martha V. Nelson. *J. Am. Med. Assn.*, XCV, 1896, December 20, 1930.

Cases studied include seventy infants ranging in age from one month to one year. Physical examinations and x-rays of the wrists were made at monthly intervals, including blood calcium and phosphorus when possible. Carefully studied x-ray appearances of normally growing bone and rachitic bone are made. Epiphyseal ends of forearm bones in rickets are ragged, with cupping and pointing of ulna at first, then increased density is noticed. Eighty-four per cent. of changes took place between two and six months of

age. All children were receiving intelligent care; also orange juice and considerable milk. Four of the infants were breast fed until six months of age. None received viosterol or violet-ray treatment. The quantity of cod-liver oil varied. The greatest number of unequalities were noticed in infants who received the greatest amount of cod-liver oil,—*viz.*, one teaspoonful daily. Improvement in density of bone was noted two weeks after increasing dose of cod-liver oil. Seventy-five per cent. of infants showed evidence of rickets before six months of age.

Conclusions are that present anti-rachitic treatment is probably inadequate, and that bone growth is not symmetrical in a growing child under one year.—*P. M. Girard, M.D., Dallas, Texas.*

Complete Rupture of the Supraspinatus Tendon. Philip D. Wilson. *J. Am. Med. Assn.*, XCVI, 433, February 7, 1931.

The author refers to Dr. Codman's pioneer work in the study of this injury and its relation to subdeltoid bursitis. Ten patients treated during a period of eighteen months, with operation on seven, is in marked contrast to recognition of only two other cases during the preceding sixteen years of practice. The lesion is common, but few surgeons are making proper diagnosis. The supraspinatus tendon with the infraspinatus and teres minor fuse with the superior and posterior portion of the capsule in attachment on tuberosities. The supraspinatus when torn retracts and makes an irregular depression or gap of one or two inches directly over the tuberosity, permitting the subacromial bursae to come in direct communication with the shoulder joint. Incomplete tears followed by imperfect healing and calcified deposits on the supraspinatus tendon, are frequently diagnosed bursitis. Complete tears were found in the seven operated cases, and in addition to the actual gap found there was in the older cases more or less degenerative changes of the tendon, as fibrillation and formation of tissue tabs. The margins at the tuberosity were smooth, and in some entirely bare.

Rupture is generally produced either by muscular strain in abduction movement, or by a direct blow on the shoulder. The youngest patient was thirty-five, the oldest above sixty. In Codman's cases the rupture frequently was a complication of anterior dislocation. Careful study of the history is necessary, because the patient may experience only slight pain and the disability is often delayed several days from the inception of injury. The typical story is of a painful snap followed by weakness and failure to gain normal strength in abducting the arm. Examination shows atrophy in shoulder group, most marked in supraspinatus position. Tenderness is present for some weeks directly over the tuberosity but may disappear when the tuberosity passes under the acromion. A coarse crepitation may be felt, described by Codman as a catch or jog, when the tuberosity crosses the rent in movements of the shoulder. There is definite weakness or loss of power in the first few degrees of abduction. General limitation of motion may result from complicating bursitis or adhesions. X-rays should be made in all cases.

Operative Treatment. For inspection an incision two inches long extends from the acromioclavicular joint downward, dividing the fibers of the deltoid. If the arm requires ninety-degree abduction to permit the tendon to reach the tuberosity, the saber incision of Codman is extended backward after separating the acromioclavicular joint. The acromion process is cut through, and with the deltoid is retracted outward to expose the shoulder region. With fascia or silk the broad band of muscle is buried in a furrow cut transversely on the face of the tuberosity, by anchoring through drill holes (six or seven) made in outer lip of furrow. The wound is closed in layers and abduction enforced for four weeks. Results are good; convalescence four to six months.—*W. B. Carrell, M.D., Dallas, Texas.*

Intertrochanteric Fracture of the Femur. S. Potter Bartley. *J. Am. Med. Assn.*, XCVI, 488, February 14, 1931.

Eighteen per cent. of fractures of the adult femur, in the author's experience, are of the intertrochanteric variety. The average age is fifty-eight, and such fractures pre-

dominate in the male. A fall backward or to the side, striking the trochanteric region, with the thigh externally rotated and abducted, is the usual mechanism responsible for such a fracture.

X-ray should always confirm the clinical diagnosis. Shortening may occur, but not to the extent encountered in fractures of the femoral shaft. Localized tenderness over the trochanter, moderate eversion of the foot, and painful crepitation on adduction or rotation usually suggest the type of fracture.

The author advocates two-plane traction as the routine treatment, and discusses the advantages of this method of treatment over the more rigid immobilization in plaster-of-Paris cast. Open operation is rarely necessary. Non-union practically never occurs. —*W. B. Carrell, M. D., Dallas, Texas.*

Non Traumatic Dislocations of the Atlanto-Axial Joint. E. J. Berkheiser and Ferdinand Seidler. *J. Am. Med. Assn.*, XCVI, 517, February 14, 1931.

Cases of atlanto-axial dislocation associated with fracture or destructive bone disease have been frequently presented in the literature. Five cases are reported by the authors, occurring in children from eight to eleven years of age, all preceded one to three weeks by an upper respiratory condition. No trauma was elicited in the history, but symptoms of torticollis and limited movements of the head appeared immediately after the dislocation. The mechanism of production is believed to be an effusion in the bursae on either side of the odontoid process, which separates this process from the transverse ligaments, stretching the latter and permitting dislocation in the same manner as in a suppurative hip joint. The deformity, which may be unilateral or bilateral, can be demonstrated by proper roentgenograms. The common type is unilateral, with the atlas carried forward on the axis, producing a torticollis with the chin directed from the afflicted side.

Reduction was accomplished in the five cases, four by traction and one by manipulation under anaesthesia, followed by plaster. The traction apparatus consists of a head-gear pull in the long axis for a few days, then hyperextension, with the patient fixed on a Bradford frame. Reduction was made in eight days in one case; five months was the longest period. Patients were allowed up in plaster, and after a few weeks with only a plaster collar or roll.—*W. B. Carrell, M.D., Dallas, Texas.*

Acute Transient Epiphysitis of the Hip Joint. O. L. Miller. *J. Am. Med. Assn.*, XCVI, 575, February 21, 1931.

Seventy-seven cases are reported of a transient inflammatory lesion of the hip occurring in children, which is characterized by a mild clinical course and early full recovery. A focus of infection was found in practically every case, and early remission followed tonsillectomy in eighty-two per cent. of the cases. The temperature rarely exceeded 100 degrees, leucocytes 10,000 to 15,000, with recovery in four to six weeks. Males were affected in a ratio of two to one. The early study of radiograms may be disappointing, but after a few days an area of rarefaction will be noted in the femoral neck next to the epiphysis, which may increase in size and extend down the neck or spread to the surface involving the joint cavity, as a secondary synovitis.

The pathology is most probably a bone necrosis from infection, infarct, or lodgement of pyemic particles in the vascular area influenced by the fragment strains in this region. The treatment is rest in bed with traction on the affected leg. Any focus of infection should be removed.—*W. B. Carrell, M.D., Dallas, Texas.*

Lunate Osteomalacia. Edward S. Blaine. *J. Am. Med. Assn.*, XCVI, 492, February 14, 1931.

Four cases of Kienböck's disease are added to the literature under the title "lunate osteomalacia".

Few authorities are in agreement on the etiology. Some hold that trauma either in the form of repeated compression strains or a single severe compression force initiates

the disease. Many observers think the characteristic changes in the lunate are due to a shutting off of the blood supply, nutritional starvation occurring, with resultant softening, necrosis, and disintegration. Others suggest embolic obstruction in the arterial supply following a minute fracture as the causative factor. In most cases reported in the literature the onset has been insidious, with or without acute injury. Often a subsequent injury, merely a blow or sprain of the wrist months or years later discloses the pre-existing pathologic condition of the lunate when roentgenograms are made. Development of the lesion is slow and symptoms are tardy in appearance.

The essential change is that of a softening of the bone with necrosis and deformity. The surgical removal of the diseased bone does not materially reduce the disability. —*W. B. Carrell, M.D., Dallas, Texas.*

Osteomyelitis Variolosa. C. F. Eikenbary and John F. LeCocq. *J. Am. Med. Assn.*, XCVI, 584, February 21, 1931.

Three cases are reported with deformities in the long bones resulting from non-suppurating lesions of small-pox. The pathology of this character of bone change has been described in the litertaure and observations made on the clinical course of the deformities. The cases reported were typical in the progressive development of variation in bone growth due to aseptic necrosis at the epiphyseal line. The premature closure following necrosis affected the length of the involved bone and in a boy at seventeen had amounted to two and one-half inches in the femur. In each of the three cases only a few of the long bones were affected. The late diagnosis is based on premature closure of the epiphyseal line with the history of increasing deformity, following an attack of small-pox.—*W. B. Carrell, M.D., Dallas, Texas.*

Removable Internal Fixation in Fractures. W. B. Carrell and P. M. Girard. *J. Am. Med. Assn.*, XCVI, 670, February 28, 1931.

Several ingenious devices used as internal fixation in the treatment of fractures are presented by the authors. A stainless steel screw with drill point and matching thread is used for oblique fractures in the long bones and T fractures into the joint. After the distal fragment is engaged by the screw, an ordinary nut is then screwed lightly against the nearer fragment, holding the fragments in perfect and secure apposition. Further immobilization is obtained by incorporating the protruding end of the screw into the plaster cast which acts as the external fixation. Removal is easily accomplished, without pain or change of plaster, after three or four weeks. In transverse or slightly oblique fractures with insecurity after open reduction a simple two-pronged fork is used. The third device is, in principle, a miniature bone clamp. This instrument is used for compound fractures, and though bulky can be removed through the open wound.

The plan of removable fixation is not proposed to meet all requirements, but in selected cases the authors have found it adequate, easily applied, and worthy a place in the armamentarium of the fracture surgeon. Due emphasis is given to methods of closed reductions, which apply to the majority of cases.—*John T. Gray, M.D., Dallas, Texas.*

The Fate of the Bone Segments after Springer Operations. E. Kasakewitsch and G. Epstein. *J. sovremennoi Chir.*, V, 156, 1930.

For the correction of marked curvatures of long bones, Springer has advocated the operation of segmental osteotomy. This consists of the resection of a portion of the tibia at its greatest curve, the division of this portion into segments, and reimplantation into the shaft of the periosteum. The authors of this article have attempted to follow the fate of these reimplanted segments, and base their conclusions upon experimental research on sixty-four guinea-pigs, upon which 108 operations have been performed. Careful radiographic and histological studies have been made, and the changes observed during a period of from nine hours to nine months.

The findings are as follows: The cells of the segments in the bone marrow cavities undergo gradual degeneration, this process beginning at the surface of the segments and working inward. The resorption of the segments begins by the tenth day, progresses very rapidly, and terminates in about six months. During the process of resorption the bone substance of the segments splits into small fragments. The later fate of these fragments is the total absorption of some, while others become involved in new bone substance and incapsulated within it. The older preparations (after six to eight months) contain only small pieces of the segments, which are involved in the newly formed bone substance. The bone marrow of the segments undergoes complete destruction. The regeneration of bone which replaces the segments is from the periosteum. This regeneration commences in ten days, and terminates about six months after the operation. The newly formed bone originates either directly from the periosteum or from the cartilaginous cells which are proliferated from the periosteum. By metaplasis the cartilage cells transform into bone substance. The tibial bone ends as well as the marrow in the proximity of the divided bone undergo the same alterations as the segments themselves.—*A. Gottlieb, M.D., Los Angeles, Calif.*

Operative Treatment of Contracture of Knees According to the Method of Wreden. R. Bakischinski. *J. sovremennoi Chir.*, V, 178, 1930.

The author reports a few cases operated on successfully by the method of Wreden. This method consists of the transplantation of the diaphysis of the femur into a canal formed in the femoral epiphysis, or, as lately modified, into a groove made in the anterior portion of the diaphyseal end of the femur.

The advantages of this method over any other advocated consist of; (1) operation in the normal region of the bone instead of in the pathological space of the joint, many such contractures being tuberculous; (2) less shortening of the leg than in resection of the knee joint; (3) retention of function of the joint if such existed before the operation, —also, less operative trauma; (4) operation above the epiphyseal cartilage, hence no interference with growth if the individual operated upon is still in the growing stage.—*A. Gottlieb, M.D., Los Angeles, Calif.*

The Etiology and Treatment of Congenital Dislocation of the Hip. Sch. D. Chachutov. *J. sovremennoi Chir.*, V, 1008, 1930.

Among all the theories advanced as etiological factors of congenital hip dislocation, the most rational one seems to be the theory of faulty development. The theory of a primary non-development of the acetabular cavity as the principal factor which favors the dislocation of the hip cannot be sufficiently proven, but the retardation of the development of the acetabulum must rather be regarded as of secondary moment.

The fact that the congenital as well as pathological absence of the head of the femur usually leads to recurrent dislocation of the hip forces the conclusion that in all probability the changes in the head of the femur in foetal life represent the primary cause for the dislocation. Based on these considerations, the theory of Wreden is the most plausible. This theory teaches that the disturbance of the normal relations of the abductor muscles of the hip, especially the gluteus medius, is the principle reason for the initial displacement of the femoral head from the acetabulum.

Two cases of congenital hip dislocation in adults are cited. They were successfully treated by König's operation, which consists of creating a bone roof and sides to guard against further displacement of the head. This operation is indicated whenever there is no fixation of the head but an inclination exists for an upward displacement. The Lorenz bifurcation operation may be left to those cases in which there exists a fixation of the head.—*A. Gottlieb, M.D., Los Angeles, Calif.*

Marble Bone (Albers-Schoenberg's Disease). N. M. Kudrjavtzev. *J. sovremennoi Chir.*, V, 1214, 1930.

The author presents three cases of marble bone in children of the same family, aged eight months to ten years. The parents are blood relatives. In all three there is present

sclerosis of bone and progressive bone processes, depending upon the age of the individual. In the older children there are found transverse ridges and lines along the diaphyseal end of the bone. The bones which are free of sclerotic areas contain marks of definite osteoporosis. In two children there is hydrocephalus, atrophy of the optic nerve, and nystagmus. In the two younger ones are found rachitic changes. In all of the children an enlargement of the skull, square form, and prominent frontal bones are noticeable. Decayed teeth and, in the older ones, a delay of secondary dentition exist. The sella turcica is thickened. In two children an increase of the inorganic phosphorus content of the blood and a morphological blood condition were found. It is known that a superfluity of phosphorus in the blood of animals is able to produce an augmentation of bone growth, and the author is of the opinion that a disturbance of phosphorus metabolism in marble bone disease is of significance. A coexistence of the marble bone with rachitic manifestations is to be noticed. The x-rays and histological photomicrographs serve to illustrate this article.

The conclusions of the author are:

1. The disease is an inherited constitutional condition.
2. The etiology of it is not definitely established.
3. The most significant findings are a systemic disturbance of the ossification of the skeleton which consists in a superfluous deposit of bone structure (osteosclerosis). Apparently this process is preceded by an osteoporotic one.
4. The degree of osteosclerosis is not in direct proportion to the disturbance of the blood which is usually found in all the grave cases of marble bone.—*A. Gottlieb, M.D., Los Angeles, Calif.*

Open Reduction of Fractures. M. M. Ljachovitzki. *J. sovremennoi Chir.*, V, 1249, 1930.

The conclusions of the author are that:

1. The open methods of reduction are more and more gaining ground.
2. Indications for open reduction are fresh fractures with wide separation of the fragments; fracture of both bones of the forearm and leg where the sites of fracture are at different levels; fracture of one bone of the forearm or leg with extensive overlapping of the fragments; and multiple fractures in the same extremity.
3. It is best to operate within one week from the day of fracture.
4. The open reduction after the expiration of three or four weeks is frequently unsuccessful, because of the biological changes which have occurred at the site of fracture.
5. The long bones should be reduced without fixation by any foreign substance if possible. An exception is allowed when the fracture is a spiral or a very oblique one, in which it would be very difficult to immobilize the fragments without internal fixation.
6. The plaster-of-Paris should be applied directly over the skin, to fix the extremity in that position which has been obtained after the open reduction.—*A. Gottlieb, M.D., Los Angeles, Calif.*

A Case of Pathological Fracture Due to Malignant Metastasis: Cure by Deep X-ray Therapy. F. Hernaman-Johnson. *Lancet*, II, 848, 1930.

Until recently, fractures due to invasion of bone by breast cancer were considered almost hopeless. This pessimistic view is no longer justifiable.

The case is reported of a female, aged forty-two, with spontaneous fracture of the femur just below the trochanter. Radiogram on discharge from the hospital six weeks later showed rarefaction of the bone in the neighborhood of the fracture. Three months after discharge she was readmitted, at which time the whole of the upper end of the femur except the head showed a worm-eaten appearance. (The patient had had a breast removed for cancer three years before the fracture.) Deep x-ray therapy was commenced. Various courses were given over a period of seven months, at which time the report was, "The metastatic invasion appears to have united".

Points worth noting are:

1. There was no violence, in the ordinary acceptance of the term.

2. Despite the fact that the metastatic growth was allowed to progress unchecked for five months, it proved possible to bring about sound union within a year's time.

3. It is impossible to say as yet what proportion of fractures due to metastatic growth will unite under deep x-ray treatment. In no case, however, should the patient be denied the chance. The presence of metastatic growth is sometimes indicated by aching of the limb, and an x-ray examination should be made of the pelvis and femora in all patients who complain of sciatica or rheumatism after operations for cancer.

In conclusion, it is noteworthy that the healing rate of a pathologic fracture may be affected by constitutional factors. Treatment by ultraviolet light occupies a very important place in "building up the system".—*A. Gibson, M.D., Winnipeg, Canada.*

TREATMENT OF THE SIMPLE GANGLION BY INJECTIONS. P. McEvedy. *Lancet*, II, 902, 1930.

The pathology is not definitely known; the commonest opinion is that it is formed by degeneration of the connective tissue in the region of the joints.

Treatment:

1. *Subcutaneous rupture.* The thick mucous fluid diffuses into the surrounding tissues and is absorbed in a few days. A cure may follow, but recurrence is frequent (fifty per cent. of cases). The traumatic inflammation following this method probably accounts for its superiority over simple aspiration.

2. *Excision.* This is usually regarded as a minor operation, but not rightly so. The operation may prove tedious and difficult, but careful and complete excision is almost certain to result in a cure.

3. *Injection.* The usual substances used are iodin and carbolic acid. These may cause much pain, and may lead to sloughing. Sodium morrhuate has been used by the author,—in many cases with satisfaction. The contents of the ganglion are aspirated, and one-half to two cubic centimeters of sodium morrhuate are injected. There may be swelling and pain for a day or two. If the ganglion is still present after two weeks, it is again aspirated and injected, the quantity of sodium morrhuate being increased. No joint pains have followed the injections, and there have been no joint complications.

As the symptoms caused by ganglia are not severe, and as the treatment is often undertaken for cosmetic reasons, operative treatment is indicated only when simpler methods have failed. Injection of sodium morrhuate offers good prospects of cure without the danger of complications.—*A. Gibson, M.D., Winnipeg, Canada.*

THE EMPLOYMENT OF INFILTRATION ANAESTHESIA IN THE REDUCTION OF FRACTURES. Carl O. Rice. *Med. J. and Rec.*, CXXXII, 423, November 5, 1930.

A brief historical review is given. This method began with Conway in 1885. The only contra-indications to its use are the presence of infection or a compound fracture. Pain is produced from periosteum, endosteum, and synovia at the fracture gap area.

Böhler produces anaesthesia immediately by infiltrating the gap. No one has reported infection or delayed healing due to this method. The procedure is to inject into the gap five to ten cubic centimeters of one per cent. procaine-epinephrine solution. If anaesthesia is not complete, the periosteum must be injected all around. In older cases some of the surrounding soft-tissue painful areas may need infiltration. Details of the injection technique are given according to the anatomic fracture regions.—*J. Kulowski, M.D., Iowa City, Iowa.*

A RÉSUMÉ OF RESULTS OBSERVED IN THE TREATMENT OF ARTHRITIC AND RHEUMATOID CONDITIONS. J. G. Ross. *Med. J. and Rec.*, CXXXII, 555, December 3, 1930.

The author studied 1255 cases of arthritic and rheumatoid conditions treated with synthetic monoiodocinchophen in an effort to estimate the therapeutic value of this drug. Eighty-four per cent., or 1055, of the patients were improved when monoiodoc-

inchophen was used, either by itself or with other drugs. Relief from pain was generally accomplished rapidly, and reduction of the swelling with restoration of motion was noted in a large number of cases. Previous investigation of a larger number of cases had revealed eighty-five per cent. improved by the administration of monoiodocinchophen.

The cases were grouped as follows: neuritis, osteo-arthritis, arthritis deformans, sciatica, arthritis, gonorrhoeal arthritis, and a miscellaneous group of forty-one cases. Idiosyncrasy in the form of nausea, vomiting, diarrhoea, palpitation, iodism, or urticaria developed in fifty-six of the 1255 cases. Gastric disturbances were controlled by alkalin.—*Robert Zollinger, M.D., Cleveland, Ohio.*

TARDY OR LATE ULNAR NEURITIS: WITH REPORT OF A CASE DEVELOPING THIRTY YEARS AFTER FRACTURE AT THE ELBOW. Moses Keschner and William Berman. *Med. J. and Rec.*, CXXXII, 480, November 19, 1930.

Keschner and Berman report a case of ulnar neuritis which developed thirty years after a fracture at the elbow. A historical review of the subject precedes the case report.

This type of neuritis seldom affects other nerves. Frequent trauma to the nerve in the vicinity of the elbow joint appears to be the principal etiological agent. No case records were found which indicated the site of trauma at any considerable distance from this joint. Signs of ulnar neuritis appearing a number of years after an injury to the elbow, especially in the presence of some deformity at the elbow, establish the diagnosis immediately. The motor fibers appear to be much more vulnerable to this type of injury than the sensory fibers, and in the presence of marked interosseous and hypothenar atrophy there may be only slight interference with sensory functions in the ulnar areas. Paraesthesias are frequently the first symptoms of the neuritis. A thickened tender nerve is often palpable behind the internal condyle. Cases with advanced muscular wasting may be mistaken for progressive muscular atrophy, but the absence of fibrillations and the presence of some sensory signs will usually eliminate this as a diagnostic possibility. In early cases roentgenography may be necessary to exclude cervical rib.

Surgical intervention offers the only satisfactory treatment for this condition. The nerve should be freed of all constricting bands, and all infringing masses removed. When the condition is a direct result of cubitus valgus deformity and the narrowing of the ulnar canal, the surgical procedure must be directed to the osseous structures. In certain cases the anterior transposition of the ulnar canal to a position in front of the median epicondyle is the operation of choice. In general, good postoperative results may be expected if the neuritis has not gone too far or the electrical reaction is not indicative of a complete reaction of degeneration.—*Robert Zollinger, M.D., Cleveland, Ohio.*

LUMBAGO UND LUMBAGO OSSEA. M. zur Verth. *Hefte zur Unfallheilkunde, Monatsschrift für Unfallheilkunde und Versicherungsmedizin Heft 5*, Leipzig, F. C. W. Vogel, 1930.

To clarify the relationship of injury to low back pain, the writer has studied the underlying local and general factors that contribute to the sudden appearance of arresting symptoms following insignificant trauma. By example he justifies the compensability of injured persons who, though predisposed to disability, were able to do their work before the accident. The whole subject of back pain is reviewed and two dry specimens of sacralized lumbar vertebrae are carefully studied. There is an exhaustive bibliography.

Lumbago is truly a constitutional disease depending on infectious, toxic, alergic, mechanical, or thermal factors. In lumbago ossea, osteo-arthritis of the spine and particularly of the lumbosacral joint is an important factor. Spina bifida occulta is of doubtful significance while lumbalizations and sacralizations play important rôles. Abnormalities of the intervertebral discs have been studied by Prof. Schmorl who

emphasizes the importance of the nucleus pulposus and cartilage displacements. Spondylolysis, spondylolisthesis, acute (horizontal) sacrum, arcuate sacrum, and the rare sacral lordosis and regio sacralis fixa are given as definite predisposing factors. Entirely exogenous causes of backache are fractures of the vertebral bodies, Kümmell's disease, and fractures of the transverse processes. Although usually insignificant, the last may cause severe local pain, with pain and atrophy of lower extremities, especially among vigorously treated compensation cases.—*W. P. Blount, M.D., Milwaukee, Wisconsin.*

Über Fehlerquellennder Exakten Untersuchungsmethoden zum Nachweis von Tuberkulose und Aktinomykose. Histologische Untersuchung, Tierversuche, Kulturverfahren. H. Friedrich. *Münchener Med. Wchnschr.*, LXXVII, August 22, 1930.

The diagnosis of tuberculosis and actinomycosis is much more difficult than usually considered. Textbook pictures are the exception and not the rule. In the contained investigation alone, diagnosis could not be made in thirty-five per cent. of all cases. Histological methods, animal investigation, and bacteriological investigation are condered.

In tuberculosis the most certain criterion is histological study. When pathological anatomical investigation gives a diagnosis of tuberculosis, all objections are overcome; but if the report comes back "non-specific inflammation, no evidence of tuberculosis", it must be carefully ruled out. Very little is found in the literature regarding the reliability of histological investigation. In malignant tumors we do not have such means. The consequent figures in most x-ray statistics would lose much in clearness not only if no exploratory excision for diagnosis is obtained, but also if we could not prove the correctness of the histological diagnosis. In tuberculosis we have in animal experimentation a good control.

Only cases with all these measures controlled are considered,—107 in all. Of these 107 cases of proven tuberculosis, in thirteen cases tuberculous tissue could not be shown after repeated investigation. At the same time, in these 107 cases clinically diagnosed as tuberculosis (with uncertainty), the diagnosis was corrected by pathological anatomical studies in two cases; in one it was syphilis and in the other it was actinomycosis. Histological investigation gave an error of ten to fifteen per cent. in the cases studied. The larger number of negative investigations was found in tuberculosis of the "*analfisteln*", tuberculosis of the "*nebenhoden*", and tuberculosis of the "*sehnenscheiden*". In most cases tuberculous tissue was easily found; in a few cases specific tissue was not found, twice even when the whole organ involved was sent over. The author has tried to blame this on the presence of a tuberculous group in which, as Poncet, Landouzy, Jadarsohn, and others have considered, specific tissue cannot be found. They are not able to prove this, however. The animal investigation was always positive and the bacilli must have been present. It was also possible in a portion of the cases to later get new material in which the typical tuberculous sections could be made. He believes that in these cases the fault lies not in another form of tuberculosis, but in the demonstration, which is unsuitable because of insufficient tissue or a too small section. If surgery and pathology overcome these obstacles, better results are obtained. He also quotes Knorr's work and his intraglandular method, bearing out these results.

Negative animal investigations in proven tuberculosis occurred in only five per cent. of the cases. It is interesting to note that the use of a larger number of animals did not reduce the source of error. When more animals were used, without exception either all the animals were ill or all were well. They attained an accuracy of ninety-five per cent. in their material which compares with the new statistics of the Clairmont clinic. They found that animal investigation was more certain than histological study. The question of time in animal investigation has been overcome by Knorr's intraglandular method. In this way ten to twenty-eight days are saved.

Especially unfavorable is the relation in actinomycosis. The histological investigation as well as the culture demonstration is in bad circumstances. They consider

twelve cases in which bacteriological and histological studies were made. In only one could the diagnosis be made microscopically as well as bacteriologically, once through histological study, four times through bacteriological study. In the remaining four cases both methods failed. Here also they found that bacteriological investigation gave better results than histological study.

He summarizes that histological study, animal investigation, and bacteriological study are all necessary.—*M. E. Pusitz, M.D., Iowa City, Iowa.*

L'Osteosynthèse Appliquée aux Fractures Fermées du Bras. P. Algrave. *Presse Méd.*, XXXVIII, November 22, 1930.

In fresh fractures of the humerus the author believes that a bone plating operation should be done for any one of the following three reasons: (a) marked displacement of the fragments; (b) pain close to or at a distance from the fracture; (c) excessive hypermobility at the point of fracture twenty or thirty days after the accident.

The article is illustrated by a series of roentgenograms of fractures of the humeral shaft showing the author's predilection for the use of steel plates, screws, nails, and wire. "*Osteosynthèse*" (bone plating) is a word much found in the fracture literature of modern France.—*Emil S. Geist, M.D., Minneapolis, Minn.*

Quelques Considérations Sur L'Osteosynthèse Fractures de L'Extremité Supérieure de Fémur. Albin Lambotte. *Presse Méd.*, XXXVIII, December 1930.

This article will be of interest to those who are still interested in the application of Lane's or Lambotte's steel plates or other types of hardware in the treatment of fresh fractures. It is quite apparent that in surgical France the use of such and similar surgical devices is on the increase. Even in fractures of the femoral neck the author favors the application of a plate, while condemning any fixative agent which might be put into the spongiosa of the femoral trochanter, neck, and head. He says, quite correctly, that these "destroy in great measure the previous osseous tissue of the neck".

In fractures of the long bones, Lambotte lays down the rule that the steel plate "must be at least five times as long as the diameter of the bone in which it is used". (This might also be a good working rule in the use of autogenous grafts—*E.S.G.*) Lambotte believes that the "grand problem of osteosynthesis is simply a question of asepsis" and thinks that when this is definitely answered the last objections to the operative treatment of fractures will have been removed.—*Emil S. Geist, M.D., Minneapolis, Minn.*

Le Nodule Fibro-Cartilagineux de la Face Postérieure des Disques Inter-Vertébraux. 1. Étude Anatomique et Pathogénique d'une Variété Nouvelle de Compression Radiculo-Médullaire Extra-Durale. Th. Alajouanine et D. Petit-Dutaillis. *Presse Méd.*, XXXVIII, December 6 and 20, 1930.

This is an excellent study of a condition which up to now has been considered rare. It is possible that increased interest in the work of Schmorl, of Dresden, will attract more attention to the pathology of the intervertebral disc. This paper is based upon two cases in which operation (laminectomy and removal of a small cartilaginous tumor originating in the disc) resulted in cure. In both cases the tumors projected into the vertebral canal and caused pressure symptoms. In both cases the tumors were situated in the lumbar region.

The authors have collected twenty-one similar cases in the literature. The article is well illustrated.—*Emil S. Geist, M.D., Minneapolis, Minn.*

Traitement des Luxations "Exposées" Du Coude. P. Wilmoth and J. Patel. *Presse Méd.*, XXXIX, 33, January 10, 1931.

The authors report two cases of compound dislocation of the elbow, one of which was complicated by injuries to nerves. Reduction was accomplished in each case after a careful debridement followed by copious lavage with ether. Primary union occurred in both cases. In the case complicated by nerve injury, later tendon transplantations were done. Motions at the elbow were satisfactory in both cases.—*Emil S. Geist, M.D., Minneapolis, Minn.*

SPONDYLITIS TRAUMATIC TARDA (KÜMMELL'S DISEASE). Edward S. Blaine. *Radiology*, XV, 551, November 1930.

Other names for this condition are "post-traumatic spondylitis" and "post-traumatic vertebral collapse". It follows trauma either slight or severe, but without actual gross compression fracture. The characteristic x-ray shadows are picked up in routine examinations without a history of fracture or even of a severe trauma, when lateral projections are made. Often these collapsed vertebral bodies are symptomless.

Kümmell described the lesion as of traumatic origin—a squeezing of the vertebral body, without fracture, local pain appearing after a few days, to disappear for a time and then reappear after months or years. This late pain extends from the back along intercostal nerves or down the legs; and a lateral radiogram discloses a partially collapsed vertebral body. Occasionally there is moderate gibbus. Radiograms made at the time of the injury have repeatedly demonstrated no fracture, in cases which later developed Kümmell's disease. The injury has been to trophic factors, so that the bone becomes devitalized and can no longer withstand pressure. The vertebral body usually becomes wedge shaped—a truncated cone in the lateral view; occasionally the setting is evenly distributed, without angulation. The process may involve the intervertebral cartilage but the intervertebral space does not entirely disappear, as in inflammatory processes.

The degree of disability from this disease is slight, a partial disability of ten per cent. to fifteen per cent. being the rule. The prognosis is good. Some writers believe the origin to be a compression fracture, perhaps microscopic, and not demonstrable in a radiogram.

Eight cases are reported, with reproductions of their radiograms.—*Edward N. Reed, M.D., Santa Monica, Calif.*

ON THE TUBERCULOUS ORIGIN OF INFECTIONS OF THE TARSAL SCAPHOID. A. Aimes and H. Estor. *Rev. d'Orthop.*, XVII, 319, July 1930.

As etiological basis of the affections of the tarsal scaphoid, also known as Köhler's disease, traumatism, developmental anomalies, and a number of other etiological factors are being quoted. Nevertheless, the etiology of Köhler's disease is still obscure. Massabuau and Marchand recently reported three interesting observations in which the scaphoiditis of the tarsal scaphoid seemed to be of tuberculous nature. The case presented by the authors confirms these previous observations. The history of the case seemed suggestive of slow onset, formation of a tumor in the tibiotarsal region, temperature elevation, etc. The x-ray showed the typical picture of scaphoiditis with fragmentation and increased density of the bone. The authors believe that this case is definitely one of Köhler's disease upon tuberculous basis.—*A. Steindler, M.D., Iowa City, Iowa.*

THE LESIONS OF BURSA MUCOSA OF THE INNER HAMSTRING TENDONS. M. LeBourgo. *Rev. d'Orthop.*, XVII, 326, July 1930.

The author had occasion to observe three such lesions of different etiology of the bursa mucosa of the inner hamstring muscles. So far as the anatomy of the region is concerned, Poirier describes a bursa mucosa of the sartorius, and one of the pes anserinus (bursa anserina), situated between the inner surface of the tibia and the inner hamstring tendons. In the first and the third cases there was involvement of the common bursa anserina; the second case was a bursitis of the sartorius bursa. Clinically the bursitis can be diagnosed by the swelling in oblong form with anterosuperior concavity. When the patient is flexing the knee against resistance, it becomes evident that the tumor is connected with the hamstring tendons or, at least, with the sartorius. In regard to the differential diagnosis, the author mentions the so called hygroma of Horsemen as described by LeFort and Albert in 1893. It is situated subcutaneously, developing at the level of the internal condyle of the femur. In other cases a cold abscess starting along the internal contour of the tibia and proceeding between a muscle layer may be mistaken for bursitis.

There is also to be remembered the cyst formation of the internal meniscus and the hygromas and bursa mucosa underlying the internal lateral ligaments, recently described by Poirier and Synncovelt. In regard to the etiology, the author distinguishes the chronic infectious, the gonorrhoeal, the traumatic, and the tuberculous types. The latter is characterized by the presence of numerous rice bodies. French authors have also described the syphilitic bursa of the inner hamstring. The prognosis varies according to whether one deals with a cyst or a hygroma, particularly with one of tuberculous origin. Extirpation is the treatment of choice in the cyst, which is followed by complete healing. In tuberculous bursitis, extirpation is also the routine treatment, but in this case complications might retard the healing and more radical procedures may be necessary when an extension into the joint has taken place.—*A. Steindler, M.D., Iowa City, Iowa.*

LATE ULNAR PALSY FOLLOWING ELBOW INJURIES. Richard J. White. *Southern Med. J.*, XXIII, 1026, November 1930.

The author reports on six cases of ulnar neuritis following elbow injuries. Ulnar palsy is the result of long continued mild trauma to the ulnar nerve in its groove at the elbow due to pinching, overstretching, or other injury which brings about a slowly developing neuritis. Neuritis of this type is first manifested by a tingling and then a gradual loss of sensation in the little finger and inner half of the ring finger. There is an atrophy of the thenar and hypothenar eminences. A marked wasting of the first dorsal interosseous, a less degree of wasting of the other interossei, a hyperextension of the metacarpophalangeal joint, and a marked flexion of the two interphalangeal joints of the little finger.

The author suggests a variety of operations:

1. A correction of the deformity at the elbow by a cuneiform osteotomy with no operation on the nerve.
2. Simple liberation of the nerve from its bed.
3. Liberation of the nerve at the elbow and placing it in a new groove made by the removal of a wedge-shaped piece of bone, lined with an aponeurotico-fascial flap.
4. Transplantation of the nerve to the flexor side of the elbow.

Dr. White has used only the last method in his treatment of ulnar palsy. He has been most successful using an exact hemostasis and gentleness, and performing this operation with only a local anaesthesia. He found it necessary to split the upper part of the flexor carpi ulnaris muscle a little to give sufficient freedom to the nerve to lie comfortably in front of the internal condyle. Whenever there is a history of an elbow injury or a marked arthritis with spur formation, and the case is not too far advanced or too long standing, the author recommends this surgery to obtain great relief with end results in from nine months to one year.—*T. H. Vinke, M.D., Iowa City, Iqwa.*

FRACTURES OF THE ACETABULUM. Wm. R. Cubbins, Arthur H. Conley, and James J. Callahan. *Surg. Gynec. Obstet.*, LI, 387, September 1930.

The need of careful examination and accurate diagnosis soon after injury is stressed, because of the bad results due to delay and poor treatment. Stereoscopic and oblique plates should be made or certain fractures will likely be missed.

The classification presented is based upon four divisions,—fractures of the acetabular rim, fractures of the acetabulum itself, perforating fractures of the acetabulum, and fractures so extensive that all the bones are involved.

A number of important facts are given concerning the pathology as it has been seen at postmortem and reported in the literature. The iliac vessels have been injured and death has resulted. The hemorrhage has surrounded the kidney, has extended anteriorly properitoneally around the abdomen beyond the mid-line, and blood has always been found about the rectum, in the perineum and scrotum. The great nerves, the bowel, and the bladder have been frequently injured.

In rim fractures there is pain on motion and loss of function with tenderness around the outer surface of the joint. Subluxation will be present in certain cases. In fractures of the ischial portion, flexion at the hip and medial rotation of the femur produces a peculiar click and jump. Slight adduction in fractures of the ilial segment may be necessary to produce a click, and in fracture of the pubic segment extension and outward rotation may bring about the position of subluxation. In perforating acetabular fractures the length of the leg may be normal, increased, or decreased; the trochanter is less prominent and may be below Nelaton's line; the foot may or may not be everted; motion at the hip is painful but flexion is usually possible; abduction is seldom possible and adduction is limited; rotation varies but is usually absent. Marked tenderness over the lower abdomen is nearly always present in perforating acetabular fractures, rigidity is common, and nausea and vomiting may be present without injury to viscera but, due to blood and fragments, irritating to the peritoneum. Fatal intra-abdominal hemorrhages from the iliac vessels have been noted many times. Blood in the urine may be from urethra, bladder, ureter, or, perhaps, from a ruptured kidney. Rectal or vaginal examination reveals a tender mass in the region of the fracture.

Emergency treatment may demand such radical measures as repairing blood vessels and viscera. The literature tells of these injuries found at postmortem, but the authors have not encountered these lesions in operations for acute abdominal conditions, and the seven cases in their fracture wards recovered. Early operative fixation of rim fractures is advised. If the case is seen late a plastic operation on the acetabulum may be indicated, though an ankylosing operation is advised by certain men. A perforating acetabular fracture calls for reduction as early as possible after injury. Flexing the thigh on the abdomen, adducting it gently, rotating the femur inward, and exerting traction with a lateral out-thrust of the femur will probably reduce the dislocation. The head may remain reduced or slip back again into the pelvis. The use of a four-inch wood-screw into the trochanter to which fifteen pounds lateral traction may be attached is advised, in addition to longitudinal traction on the leg. The leg is supported in a Thomas splint. The lateral traction may be lessened after a few days but should be continued for six weeks. No weight-bearing is allowed for four to six months and then with crutches with minimum weight-bearing for four months.

Roentgenograms of eight patients are published indicating poor results from treatment by traction on the fracture table followed by casts, poor results from delayed treatment, and superior results from the early application of the lateral and longitudinal traction treatment. —*Hugh Jones, M.D., Los Angeles, Calif.*

THE EFFECTS OF THE ELECTROCAUTERY ON NORMAL TISSUES. J. Gottesman, D. Perla, and J. M. Ziegler. *Surg. Gynec. Obstet.*, LI, 667, November 1930.

This is an experimental study of the effect of the electrocautery incision in the skin, muscle, liver, kidney, and spleen in normal adult albino rats as compared with the scalpel wound. In all of these rats incisions were made by both methods. The rats were then autopsied at regular intervals, and microscopic studies through the incised areas made. It was found that in all instances the electrocautery retarded healing because the extensive resultant contiguous necrosis acted as a foreign body. After eight days, when the scalpel wounds had already healed, giant-cell reaction of the foreign body type set in.

Secondary hemorrhage is the distinct danger if larger coagulated vessels slough. In incising infected tissue the burden of further necrosis must be added to the process of repair. In cancerous tissue the wounds heal more slowly and readily suppurate. The lymphatic channels are blocked off, and this, added to the already removed glands, results in a brownish oedema with lowered tissue vitality.

The authors state that the use of the electrocautery is warranted only when it is desired to destroy tissue that is inaccessible to the scalpel, and when the control of capillary bleeding is difficult.—*J. Kulowski, M.D., Iowa City, Iowa.*

INJURIES TO THE SEMILUNAR CARTILAGES OF THE KNEE JOINT. M. S. Henderson. *Surg. Gynec. Obstet.*, LI, 720, November 1930.

The author divides injuries of the internal semilunar cartilage into four classes:

1. A tag-like flap torn from the anterior portion and hanging free from its basal attachment.

2. The same occurring at the middle portion and easily overlooked at operation.

3. Bucket-handle or loop type which is most common.

4. A pedunculated flap in the posterior one-third, giving rise often to bizarre symptoms, and also liable to be overlooked.

He reviews 256 cases. In five cases, more than one cartilage was removed. Twenty-two cases were of the external cartilage. In the bucket-handle type there was lacking the usually intervening period of freedom from symptoms.

The differential diagnosis is not always easy. Atypical histories are usually due to fat tags, loose bodies, and osteochondritis dissecans.

Surgery is indicated in all cases not cured by conservative measures. A straight incision is made from the middle of the patella to just below the level of the head of the tibia, as near the juncture of the anterior and middle one-third of the cartilage as possible. The posterior portion is best removed through a lateroposterior incision. It is best to leave a small rim of cartilage. The splint is removed after five days and active motion begun. Walking is permitted in eight days. Many of the unstable knees following operation are due to an original injury of the crucial ligaments.

Results were traced in 238 cases. Seventy-seven per cent. were completely cured, fourteen per cent. improved, and nine per cent. not improved. There were no fatalities and no infection. In forty-two cases no demonstrable pathology was noted but the cartilages were removed because of the typical symptoms. Of these, thirty-five cases were traced—thirty-seven per cent. were cured, twenty-three per cent. improved, and forty per cent. not improved. The cures following the removal of the external cartilage did not equal the internal cases.—*J. Kulowski, M.D., Iowa City, Iowa.*

ON THE SO CALLED MARCH TUMOR (Syndesmitis metatarsea). Aleman. *Tidskrift i militär sjukvard*, No. 4, 1929.

The history is reviewed. An investigation into the frequency of this condition in the army is submitted on the basis of official reports to the Executive Medical Board of the Army.

A table is given, showing the frequency of occurrence of "march tumors" in the Swedish Army from 1914 to 1928. During this period there were 11,338 cases in the infantry, 54 in the artillery, 32 in the cavalry, and 112 in the engineering troops.

The author's own material is made up of 280 cases from the surgical department of the Stockholm Military Hospital. The condition occurred among the different metatarsal bones as follows: 143 in the second, 123 in the third, and nine in the fourth, which corresponds to a rate of fifty-three per cent., forty-four per cent., and three per cent.

It is clear that the condition is mainly found in the foot-soldier, and it is emphasized that the injuries do not occur at the beginning of the training period as one might expect on account of the then insufficient training. Instead they are met with at the end of the training period, and during regimental manoeuvres when strenuous marches are being performed in full kit.

The human foot is not in itself a stable organ of support, but an organ of movement meant for muscular work. In accordance with its nature it tolerates weight-bearing better during movement than during rest. In the case of muscular power wavering in the foot during movement, a state of insufficiency sets in which necessarily precedes march injuries in the second, third, and perhaps the fourth metatarsal bones. In the author's opinion the term "insufficiency lesions of the metatarsal bones" should take the place of "syndesmitis metatarsea".

It is shown that statically well developed feet as a rule become the seat of this condition. Flat-foot is in fact a prophylaxis against this kind of lesion.

The treatment consists of a foot plaster in which the patient can be out of bed after a week. The plaster is removed after four weeks. After six weeks the patient generally returns to full duty. The importance of suitable footwear for preventing such lesions among the troops is being emphasized; above all it must be seen to that the boots are not too broad, as the metatarsus then lacks lateral support.

There are extensive references to literature.—*Harald Nilsonne, M.D., Stockholm, Sweden.*